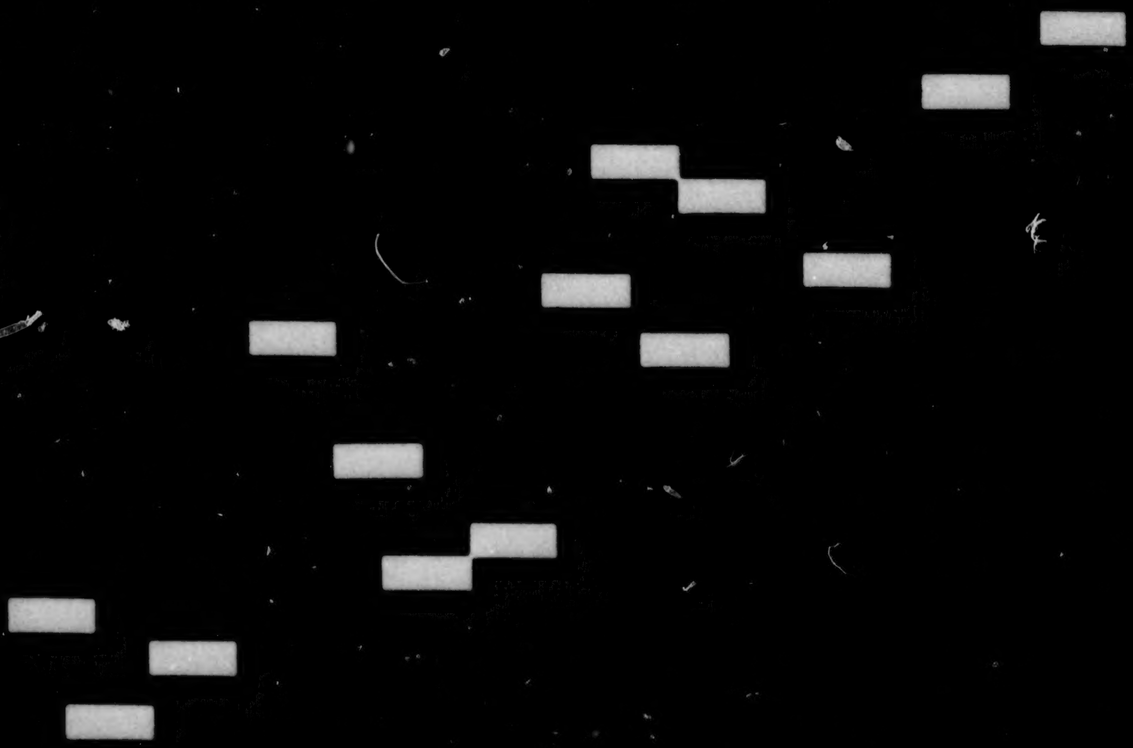
JUN 11 1987

NS1.2: R31/38

NATIONAL SCIENCE FOUNDATION

SCIENCE AND ENGINEERING RESEARCH FACILITIES AT DOCTORATE-GRANTING INSTITUTIONS

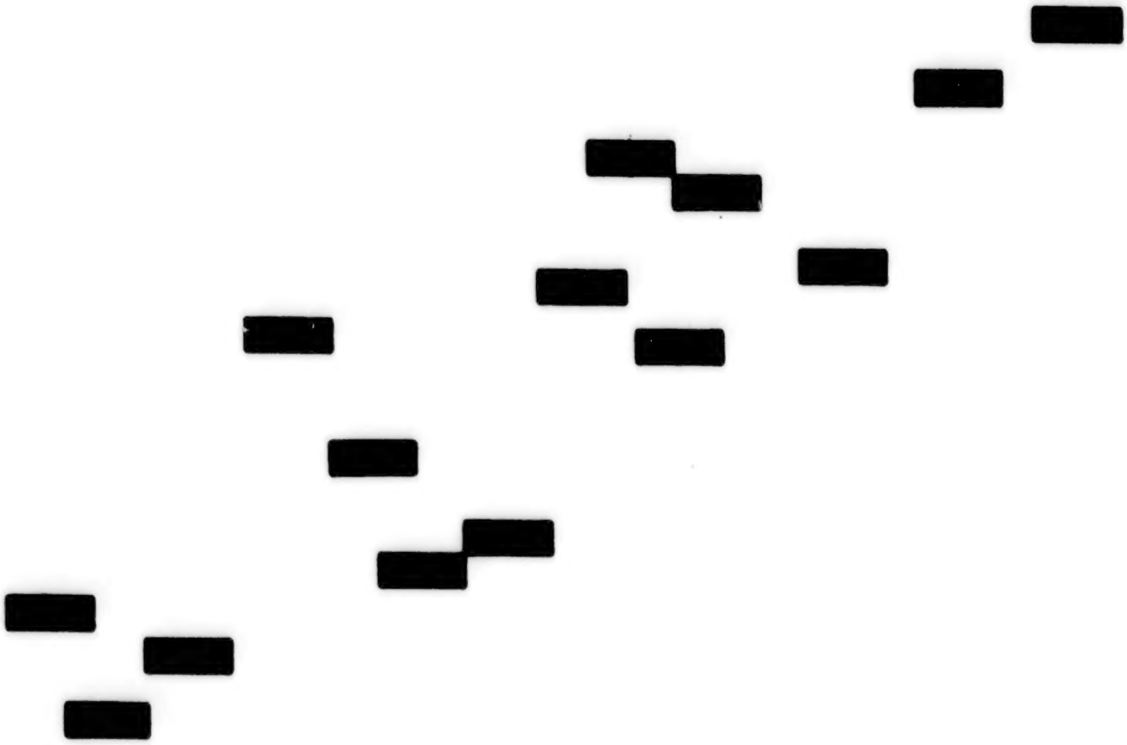


COMPLETED

SEPTEMBER 1986

NATIONAL SCIENCE FOUNDATION

SCIENCE AND ENGINEERING RESEARCH FACILITIES AT DOCTORATE-GRANTING INSTITUTIONS



SEPTEMBER 1986

FOREWORD

The Nation depends upon its universities for the intellectual resources and new knowledge necessary to maintain and strengthen our ability to compete in work markets. Our advances in research depend on the quality of the scientific and technical personnel and the physical facilities available to universities and colleges. Although research facilities -- bricks and mortar -- are an essential component of academic science and engineering capabilities, we have relatively little quantitative information about them.

Acting out of the concern expressed by the academic community, Congress instructed the Foundation to collect data on the status and condition of academic research facilities and to submit a report to Congress. This report marks the beginning of systematic study of the support and condition of academic research facilities through regular, periodic surveys of the Nation's universities and colleges.

Erich Bloch
Director
National Science Foundation

ACKNOWLEDGEMENTS

This report was prepared within the Science Resources Studies Division by Christina C. Wise, Science Resources Analyst, Science and Engineering Education Sector Studies Group. Mary A. Collins, Higher Education Surveys Project Director, Westat, Inc., contributed to the design and execution of the study, and the analyses of the data. Engin I. Holmstrom contributed to the preliminary analysis of the data and Laurie Lewis assisted in the preparation of the final report. Guidance and review was provided by Mary A. Golladay, Study Director, Science and Engineering Education Sector Studies Group; Charles H. Dickens, Head, Surveys and Analysis Section; William L. Stewart, Director, Division of Science Resources Studies; and Richard J. Green, Assistant Director of NSF for Scientific, Technological, and International Affairs.

Special acknowledgement is made of the over 400 academic officials who responded to the two Higher Education Surveys upon which the report is based.

TABLE OF CONTENTS

Page

Executive Summary xiii

Introduction 1
  Data Collection 2
  Report Format 3
  Future Work 3

Section 1: Status of Academic Research Facilities 5
  Introduction 5
  Research Space in Academic Year 1985-86 6
  Effect of New Construction on Research Space 8
  Distribution of Facilities Expenditures 9
    Work in Progress: 1985-86 11
    Planned Work: 1986-1991 13
  Sources of Funding for R&D Facilities 14
    Work in Progress: 1985-86 15
    Planned Work: 1986-1991 15
  Age of Research Facilities 18

Section 2: Assessment of Academic Research Facilities 21
  Introduction 21
  Research Administrators 22
  Deans 25
  Institutional Differences 28

Section 3: Assessment of Academic Research Facilities in Specific Areas 33
  Introduction 33
  Engineering 37
  Physical Sciences 39
  Environmental Sciences 41
  Mathematical Sciences 43
  Computer Sciences 45
  Life Sciences 47
  Medical Sciences 49
  Psychology 51
  Social Sciences 53

Technical Notes 55
  The Samples 55
  The Survey Instruments 56
    The Mail Questionnaire 56
    Data Considerations 56
    The Telephone Questionnaire 60
  The Response Rates 60

Appendix A: Tables A-1

Appendix B: Questionnaires B-1

List of Tables

Text Tables **Page**

1 Space Devoted to Research at Doctorate-Granting Universities, 1986 7

2 Net Increase in Research Space Square Footage Resulting from Construction in Progress and Planned 8

3 Average Cost of Facilities-Related Work in Progress by Condition of Facilities 32

4 Number of Institutions Reporting Facilities-Related Work 59

5 Average Proportion of Academic Research Facilities Built or Renovated in Selected Time Periods, by How Item Was Reported 59

6 Response Rates to Mail Survey 61

Appendix Tables

A-1 Costs to Complete Facilities-Related Work in Progress, 1985-86 ..... A-3

A-2 Costs to Complete Facilities-Related Planned Work, 1986-1991 ..... A-4

A-3 Sources of Funding for Facilities-Related Work in Progress, 1985-86 .... A-5

A-4 Sources of Funding for Facilities-Related Planned Work, 1986-1991 .... A-6

A-5 Average Proportion of Academic Research Facilities Built or Renovated in Selected Time Periods A-7

A-6 Academic Officials' Opinions Regarding Condition of Campus Research Facilities, 1986 .... A-8

A-7 Academic Officials' Assessments of Sufficiency of the Amount of Research Space A-9

A-8 Academic Officials' Identification of Most Critical Need in Terms of Research Space A-10

A-9 Academic Officials' Assessment of Major Problem Facing Research in Next Five Years A-11

Appendix Tables (continued) **Page**

A-10 Academic Officials' Identification of Funding Priority A-12

A-11 Proportion of Academic Officials Citing Effects of Facilities Needs on Research Programs A-13

A-12 Proportion of Academic Officials Citing Problems in Addressing Facilities Needs A-14

A-13 Research Administrators' Opinions Regarding Condition of Campus Research Facilities, 1986 .... A-15

A-14 Research Administrators' Assessment of Sufficiency of the Amount of Research Space A-16

A-15 Research Administrators' Identification of Most Critical Need in Terms of Research Space A-17

A-16 Research Administrators' Identification of Funding Priority A-18

A-17 Proportion of Research Administrators Citing Effects of Facilities Needs on Research Programs A-19

A-18 Proportion of Research Administrators Citing Problems in Addressing Facilities Needs A-20

A-19 Oldest and Newest Facilities: Date of Construction or Most Recent Renovation A-21

List of Charts

Chart		Page
1	Distribution of Facilities-Related Expenditures for Work in Progress, Academic Year 1985-86	10
2	Distribution of Facilities-Related Expenditures for Planned Work, 1986-1991	10
3	Universities Reporting Facilities-Related Work in Progress, Academic Year 1985-86	11
4	Universities Reporting Facilities-Related Planned Work, 1986-1991	13
5	Sources of Funding for Facilities-Related Work: All Universities	16
5a	Sources of Funding for Facilities-Related Work: Public and Private Universities	17
6	Average Proportion of Facilites Built or Renovated in Selected Time Periods	19
7	Academic Officials' Opinions Regarding Condition of Research Facilities	22
8	Academic Officials' Assessment of Sufficiency of Research Space	23
9	Academic Officials' Identification of Most Critical Research Space Need	24
10	Academic Officials' Assessment of Effects of Research Facilities Needs	26
11	Academic Officials' Opinions About Problems Addressing Facilities Needs	27
12	Research Administrators' Assessment of Facilities' Condition and Need	29
13	Facilities Construction Activities and Deans' Assessments of Facilities Condition and Need	34
14	Age Ranges of Newest and Oldest Research Facilities	35

EXECUTIVE SUMMARY

To address its need for information "identifying and assessing the research facilities needs of universities"[1], Congress directed the National Science Foundation to collect and analyze data and to report on the status of academic research facilities.

This report presents the Foundation's initial response to the legislative requirement. It is based on two quick response surveys conducted in spring 1986. The survey universe included all doctorate-granting institutions.

Current and Future Activities

Almost all doctorate-granting institutions have some facilities-related activities -- major repairs, renovations, or new construction -- in progress or planned. However, the schools ranked in the top 50 in terms of research and development expenditures accounted for more than half of the facilities-related spending and research space, both current and planned. Furthermore, in a majority of these schools, facilities were reported to be in good or excellent condition, according to their research administrators.

When completed, new construction currently in progress will increase research space at all doctorate-granting institutions by as much as 7 percent. New construction planned between 1986 and 1991 will increase existing space by as much as 19 percent.

In academic year 1985-86, the estimated costs to complete all facilities-related work in progress -- major repairs, upgrading and renovation, and new construction -- was $1.7 billion. The costs to complete work planned between 1986 and 1991 was estimated to be $5.8 billion. The top 50 schools accounted for over 50 percent of the costs of work in progress in each of the three areas; they accounted for over 60 percent of the estimated costs for planned work in each area.

---

[1] National Science Foundation Authorization Act of 1985 (P.L. 99-159, Section 108)

Sources of Funds

The major sources of funds for facilities-related activities are state governments and private donations and endowments. Tax-exempt bonds are another major source of funds, financing almost a third of the new construction and renovations in progress. The Federal government is providing about 10 percent of the costs of facilities-related work in progress, and universities expect this share to decline over the next five years.

In general, top 50 schools rely more on private donations and endowments than do other schools to finance maintenance, renovation and construction of facilities. Over the next five years, all universities expect private sources to support a greater share of facilities-related work.

Condition and Needs

A majority of the research administrators and deans at top 50 schools reported the condition of research facilities on their campuses as good or excellent. A majority of those officials responding for schools ranked below the top 50 rated the condition of their research facilities as fair or poor.

Virtually all campuses need more research space according to their research administrators and deans. Ninety-five percent of the research administrators said they had less space than they needed. Seventy-five percent of them said that additional space was a more critical need than repairing and upgrading existing space. Compounding the problem, especially among institutions ranked below the top 50, was the lack of space on campus on which to build additional research facilities.

Over 80 percent of the research administrators said that facilities needs limited the number and type of projects that could be carried out on their campuses and that it had been necessary to divert funds from other research areas to maintain and/or repair facilities. A majority of the deans representing nine specific science and engineering areas made the same assessment.

Overall, research administrators and deans agreed that facilities funding is a "marginal" expense relative to support for personnel and equipment. That is, spending for improvement and expansion of facilities is most likely to increase when new funds are available and most likely to be reduced first when funds are cut.

About a third of the research administrators agreed that facilities needs were the most pressing research-related problems on their campus in the next five years. In contrast, the responses of the deans varied by area. The proportion of deans who considered facilities needs the greatest problem ranged from 59 percent of those representing physical sciences to 23 percent of those speaking for social sciences.

In general, engineering and medical, life and physical sciences appear to dominate the campus-wide assessments of research facilities needs by academic officials. Both current and planned facilities construction are concentrated in these areas. Specifically, research administrators most frequently cited engineering and biological, biomedical, and physical sciences, animal care facilities and biotechnology as areas with significant facilities needs.

Environmental sciences was one area in which the deans identified important facilities needs, yet there was relatively little construction activity. Seventy-three percent of the deans representing environmental sciences characterized the condition of their facilities as only fair or poor, and 47 percent said that facilities needs were the most pressing research problem on their campus in the next five years, a higher proportion of the deans than in any other field except physical sciences.

INTRODUCTION

The Nation's universities and colleges represent an important partner, together with the Federal and State government, industry, and other private and public organizations, in the growth of U.S. science and technology, and in our ability to develop and maintain a knowledge base for future economic growth and stability.

Recent Congressional testimony has revealed a growing concern throughout the science and engineering community about reports of a deterioration in the physical plant resources needed to sustain a strong academic research capability. There has been, however, little quantitative information to support this concern or to provide a basis for an informed assessment of academic research facilities needs.

To address this need for information, Congress called upon the National Science Foundation, in the Act of November 22, 1985 (P.L. 99-159, Section 108):

> ...to design, establish, and maintain a data collection and analysis capability in the Foundation for the purpose of identifying and assessing the research facilities needs of universities.... The Foundation, in conjunction with other appropriate Federal agencies, shall conduct the necessary survey every 2 years and report the results to the Congress.

This report presents the Foundation's initial description of the amount and quality of academic research facilities. To assist Congress in identifying facilities needs, the report provides information on the amount of space devoted to research at doctorate-granting institutions, expenditures on facilities-related activities in progress and planned, as well as the age of research facilities. In addition, the report summarizes research administrators' and deans' assessments of facilities needs on their campuses based on 400 interviews. Besides presenting the research administrators' overall assessment of facilities needs, the report offers the deans' appraisals of needs in nine areas, eight science fields (medical, life, computer, social, mathematical, physical, and environmental sciences and psychology) plus engineering.

Data Collection

As a first step in building a data base on academic research facilities, the Foundation began survey activities in spring 1986. Two separate efforts were undertaken simultaneously, one to collect quantitative information on research facilities-related expenditures and space, and the other to obtain from knowledgeable university officials information on their assessment of the needs and problems pertaining to research facilities.

These initial efforts were restricted to doctorate-granting institutions in order to meet the due date for the first report to Congress. In addition, it was necessary to limit coverage in this first effort to the collection of aggregate data on science and engineering facilities; institutions were unable to provide detailed data on expenditures and space in individual science and engineering areas within the time available.

The 165 universities involved in these surveys represent all institutions designated as doctorate-granting in the Department of Education Higher Education General Information Survey that have dedicated research space. They accounted for about 83 percent of total research and development expenditures at universities and medical schools in 1984, of which public universities accounted for 53 percent and private universities accounted for 30 percent. Top 50 schools accounted for 58 percent of total expenditures in 1984.

A mail survey of all 165 doctorate-granting institutions collected baseline data on the amount of space devoted to research and development; the costs associated with major repairs, upgrading and renovation, and new construction; and the age of facilities for each of nine science and engineering areas. It also established the age of the oldest and newest facilities and facilities construction under way. These data were needed to establish the basic parameters of the current situation.

A telephone survey of a subsample of 81 of the 165 institutions collected the perceptions of facilities needs from 80 research administrators and 175 deans representing 318 programs in nine science and engineering areas. The interviews were concerned with the overall condition of research facilities, the adequacy of research space in terms of the amount and condition, the priority given to facilities-related concerns, the effects of facilities constraints on universities' research programs, and problems encountered by the universities in addressing research facilities needs. These opinions of senior academic officials provide a sense of the priority for needs across science and engineering fields. (See the Technical Notes section for detailed discussion of the study methodology.)

Report Format

This report summarizes the findings of these two surveys in three sections. Section I presents data collected in the mail survey on the current status of academic research facilities at doctorate-granting institutions. It presents information on the amount of space used for research and development; costs associated with the repair, renovation and construction of facilities; sources of funding for research-related building projects; and the age of research facilities at surveyed universities.

Section II presents opinions of research administrators and deans on the condition of research facilities at a subset of the institutions involved in the first survey. This section describes and compares the results of 398 telephone interviews discussing the amount and quality of research space, the effects of facilities constraints on research capabilities, and the perceived problems in addressing facilities needs. Section III presents separate summaries of the deans' opinions on research facilities needs in nine science and engineering areas.

Future Work

As this report goes to press, efforts are underway to expand the scope of the NSF academic research facilities survey to include information on predominantly undergraduate and historically black institutions. In addition, quantitative data will be reported for individual science and engineering areas. These enhancements, together with improvements in the ability of institutions to extract and interpret data from their records, are expected to provide a more detailed picture of the condition and needs of academic research facilities.

Section 1: Status of Academic Research Facilities

Introduction

Almost all doctorate-granting institutions are currently engaged in some facilities-related activities -- major repairs, renovations, or new construction -- or plan such work within the next five years. Much of the current and planned activity, however, is concentrated in the top 50 institutions ranked in terms of research and development expenditures in 1984 (hereafter called top 50 schools).

This baseline survey revealed that academic research space is fairly concentrated in a relatively small proportion of the universities. These schools, which also spend the most on research and development, will continue to have more research space according to the reported plans for future work. Top 50 schools, on average, have roughly three times as much space as schools ranked below the top 50. Furthermore, top 50 schools expect to add about 12.3 million square feet of research space between 1985 and 1991, about 25 percent more than the planned increase in square footage at other institutions.

Top 50 schools accounted for 55 percent of the estimated 83.8 million square feet of research space at doctorate-granting institutions in academic year 1985-86. These same schools account for 50 percent of the estimated 6 million square feet added by new construction in progress, and 58 percent of the 16 million square feet to be added between 1986 and 1991.

The estimated completion cost of all facilities-related work in progress in academic year 1985-86 was $1.7 billion. For comparison, expenditures on research and development at doctorate-granting institutions totaled about $9.3 billion in 1985. The completion cost of facilities-related work planned over the period 1986 to 1991 is expected to be $5.8 billion.

The universities with the most existing space reported the largest expenditures for work in progress and work planned over the next five years. In academic year 1985-86, top 50 schools accounted for 56 percent of the $112.9 million spent on repairs, 55 percent of the $288.9 million spent on upgrading and renovation, and 55 percent of the $1.3 billion spent on new construction. Over the next five years, these schools account for even larger proportions of planned completion costs: 60 percent of the $615.7 million budgeted for repairs, 76 percent of the $1.1 billion budgeted for upgrading and renovation, and 63 percent of the $4.0 billion allocated for new construction.

The following sections present detailed information on the amount of space used for research; costs associated with repair, renovation and new construction of facilities; sources of funding for research-related building projects; and the age of research facilities at doctorate-granting institutions.

Research Space in Academic Year 1985-86

The amount of space devoted to research varies greatly among institutions. While the average was 513,000 square feet, amounts ranged from 3,600 to 3.3 million square feet.[2] The distribution was skewed toward the lower end: 50 percent of the institutions had 350,000 square feet or less of research space and 75 percent had less than 700,000. Ten percent of the universities had more than one million square feet devoted to research.

As would be expected, the amount of research space is greater at the top 50 schools (Table 1). On average, they have over three times as much research space as other institutions (1,032,000 square feet versus 315,000.). Universities with medical schools also reported more research space, about 32 percent more, than those without medical schools (an average of about 591,000 compared with 448,000 square feet).

There is a significant positive relationship between the amount of research space and the level of research and development expenditures at doctorate-granting institutions; that is, universities with more research space generally spend more on research and development. However, the differences in expenditures among institutions exceed the differences in research space. For example, top 50 schools account for 67 percent of 1984 research and development

---

[2] These figures exclude space devoted to instruction; however, space used jointly for research and instruction is included.

Table 1. Space[1] Devoted to Research at Doctorate-Granting Universities, 1986.

	Type of University						
	All	Top 50	Below Top 50	With Medical School	Without Medical School	Public	Private
Total No. of Institutions	165	47	118	75	90	108	57
Average Square Feet[2]	513,000	1,032,000	315,000	591,000	448,000	516,000	506,000
Average 1984 R&D Expenditure Per Square Foot of Research Space[3]	$90	$120	$80	$110	$80	$80	$120

[1] Respondents were asked to report the square footage as calculated for OMB Circular A-21. Therefore, this figure represents space for which indirect costs are recoverable.

[2] Average square feet based on responses only.

[3] Average based on those institutions reporting both square feet and R&D expenditures.

expenditures among all doctorate-granting institutions, compared to 55 percent of research space. Therefore, the ratio of 1984 research and development expenditures to the number of square feet devoted to research is higher at top 50 schools. The same situation holds for universities with medical schools and private institutions.

As the measure of research space, the survey used the net assignable square feet associated with research and development as stated on OMB circular A-21, a figure which represents the amount of space for which indirect costs are recoverable. While this was the figure most readily available at sampled institutions, and most uniform in calculation, the reader should bear in mind that the total amount of space used for research at some universities may be greater than the amount of space that is recoverable under Federal grants and contracts. Thus, using the A-21 figure results in a slight underestimate of the total amount of space (net assignable square feet) devoted to research.[3]

---

[3] For a more detailed discussion of the implications of using the A-21 figure to measure research space, see the Technical Notes.

Table 2. Net Increase in Research Space Square Footage Resulting from Construction in Progress and Planned.

	Type of University						
	All	Top 50	Below Top 50	With Medical School	Without Medical School	Public	Private
Construction in Progress							
No. of Institutions	84	31	53	42	42	62	22
Average Square Feet	73,000	98,000	58,000	83,000	62,000	75,000	65,000
Planned Construction							
No. of Institutions	109	39	70	51	58	74	35
Average Square Feet	147,000	237,000	97,000	189,000	111,000	138,000	167,000

Effect of New Construction on Research Space

In general, institutions which currently have a greater amount of research space, top 50 schools and universities with medical schools, are more likely to have construction in progress and planned. As a result, the overall distribution pattern of research space among doctorate-granting institutions is not likely to change over the next five years.

In academic year 1985-86, about half of the universities were in the process of building new research facilities which would result in an average net increase of 73,000 square feet (Table 2). In addition, over half of the universities reported planned construction over the next five years which would add, on average, about 147,000 square feet of research space per institution.[4] Based on these figures, the estimated increase in research space due to new construction in progress ranges from 4 percent to 7 percent. Over the next five years, the estimated increase will range from 10 percent to 19 percent.

---

[4] For new construction, survey respondents provided estimates of total square footage assignable as research space. These estimates are not strictly comparable to the "recoverable" square footage figures provided in response to the question about current space devoted to research and development.

Top 50 schools were more likely than other institutions to report additions to space due to current construction (66 percent versus 45 percent). In addition, the average addition to research space was greater at top 50 schools (98,000 square feet compared with 58,000 for other institutions). A similar pattern was observed for planned construction and for the increase in square footage resulting from planned construction.

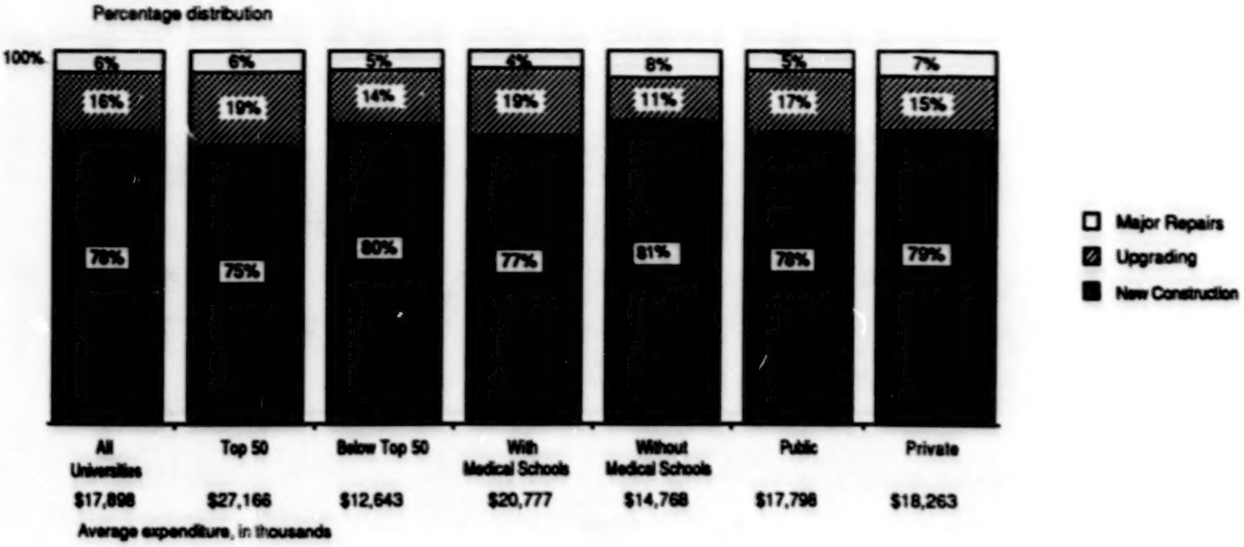
Relatively more public (57 percent) than private (39 percent) universities are now increasing their research space, and their average addition is greater (about 75,000 square feet compared to 65,000 square feet). Over the next five years, a slightly higher proportion of public institutions (69 percent compared to 61 percent) are planning to increase research space through facilities construction. However, on average, the additional square footage will be slightly greater among private universities. Therefore, if plans are fulfilled, the current distribution pattern of research space will change little over the five year period.

Distribution of Facilities Expenditures

The distribution of current construction expenditures is relatively consistent across all universities, with nearly 78 cents out of each dollar going to build new facilities, 16 cents to upgrading and renovation, and about 6 cents to major repairs (Chart 1).

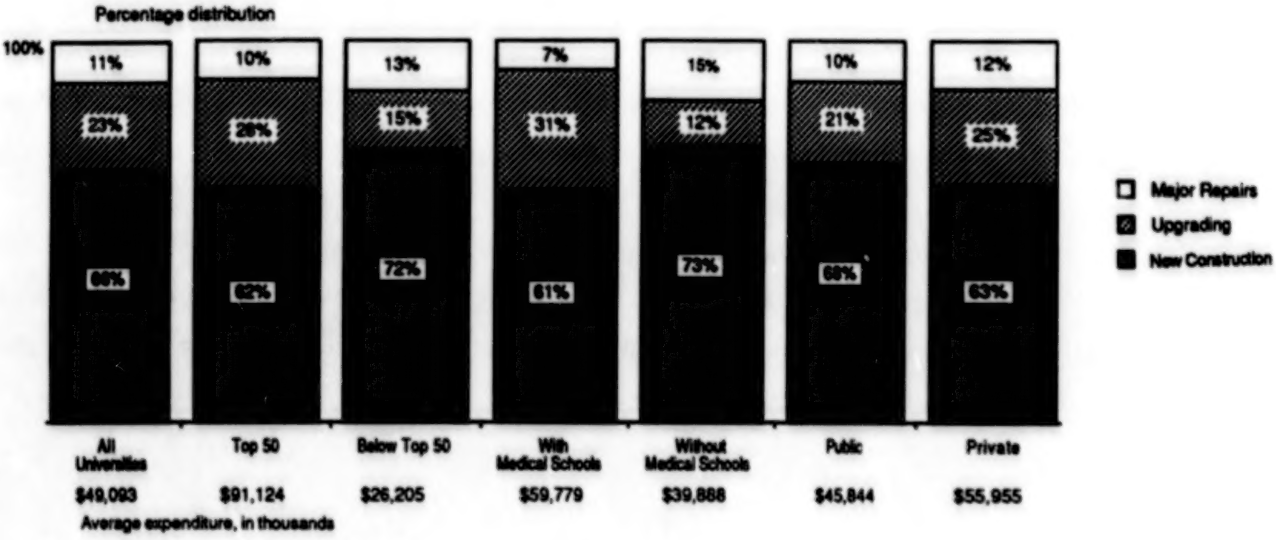
Over the next five years, a relatively smaller share of each research facilities dollar will go to new construction and more will go to both upgrading and renovation and repairs. On average, only 66 cents out of each dollar will be spent on new building in the next five years, compared to 23 cents on upgrading and renovation and 11 cents on major repairs (Chart 2).

Chart 1. Distribution of Facilities-Related Expenditures for Work in Progress, Academic Year 1985-86



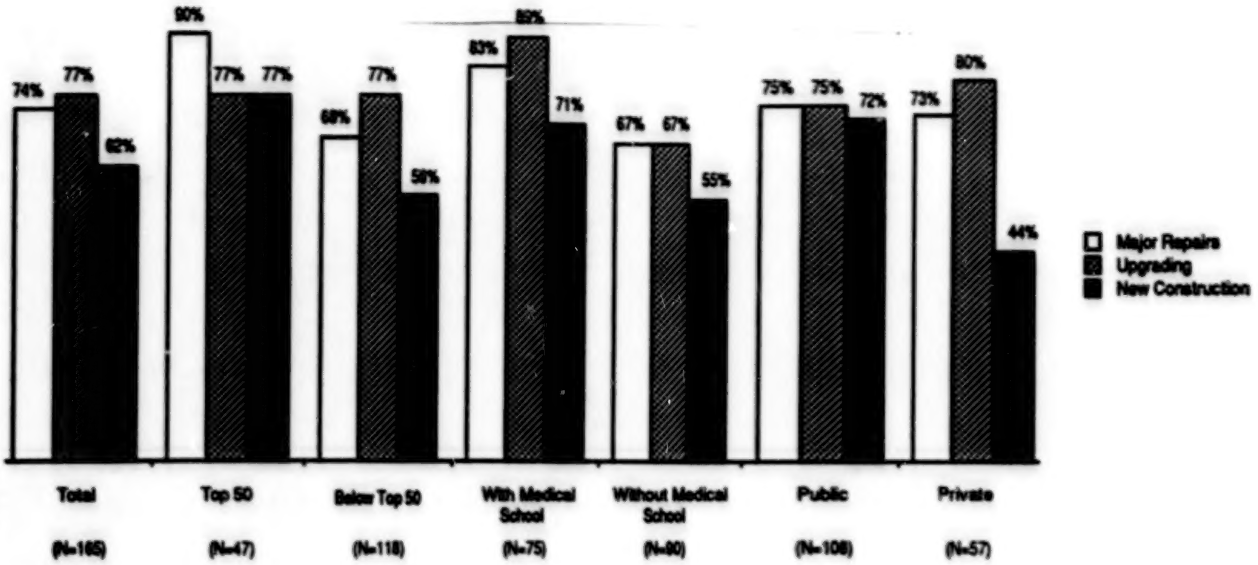
Note: Percents may not add to 100 because of rounding
Reference: Appendix Table A-1
Source: National Science Foundation

Chart 2. Distribution of Facilities-Related Expenditures for Planned Work, 1986-1991



Note: Percents may not add to 100 because of rounding
Reference: Appendix Table A-2
Source: National Science Foundation

Chart 3. Universities Reporting Facilities-Related Work in Progress, Academic Year 1985-86



Reference: Table 4
Source: National Science Foundation

Work in Progress: 1985-86

Universities, in general, are actively engaged in maintaining and improving the research facilities on their campuses. A majority of the institutions surveyed (62 percent) reported new construction in progress. About 77 percent reported that they were upgrading, renovating or making major repairs on existing facilities (Chart 3).

Among the institutions that reported expenditures for **new construction** in progress, the average expenditure[5] was about $14 million dollars (Appendix Table A-1). Striking differences existed between top 50 schools and others: 77 percent of the former reported new construction in progress, compared with 56 percent of the latter. In addition, the average cost of the construction was about twice as high in the top 50 schools -- about $20 million compared with about $10 million.

---

[5] Information was collected on the cost to complete work in progress and planned. In most cases, funds are expended in one year, however some construction projects extend beyond one year.

The proportion of universities with medical schools having **new construction** in progress was greater than that of those without (71 percent compared to about 55 percent). Those with medical schools also reported new construction costs about one-third higher than those without -- about $16 million compared with about $12 million.

Public universities were more likely than private universities to have new construction in progress (72 percent compared to 44 percent). The average completion costs, however, were about the same, $14 million.

About 77 percent of all universities reported that they were **upgrading** or **renovating** existing research facilities. The average reported expenditure was about $2.9 million. Again, top 50 schools were spending more than twice as much on upgrading and renovation ($5.3 million compared to $1.8 million). In addition, universities with medical schools were spending twice as much on renovation as those without ($3.9 million compared to $1.6 million, on average). Private universities were more likely than public universities to be upgrading and renovating research facilities, but the latter were spending slightly more.

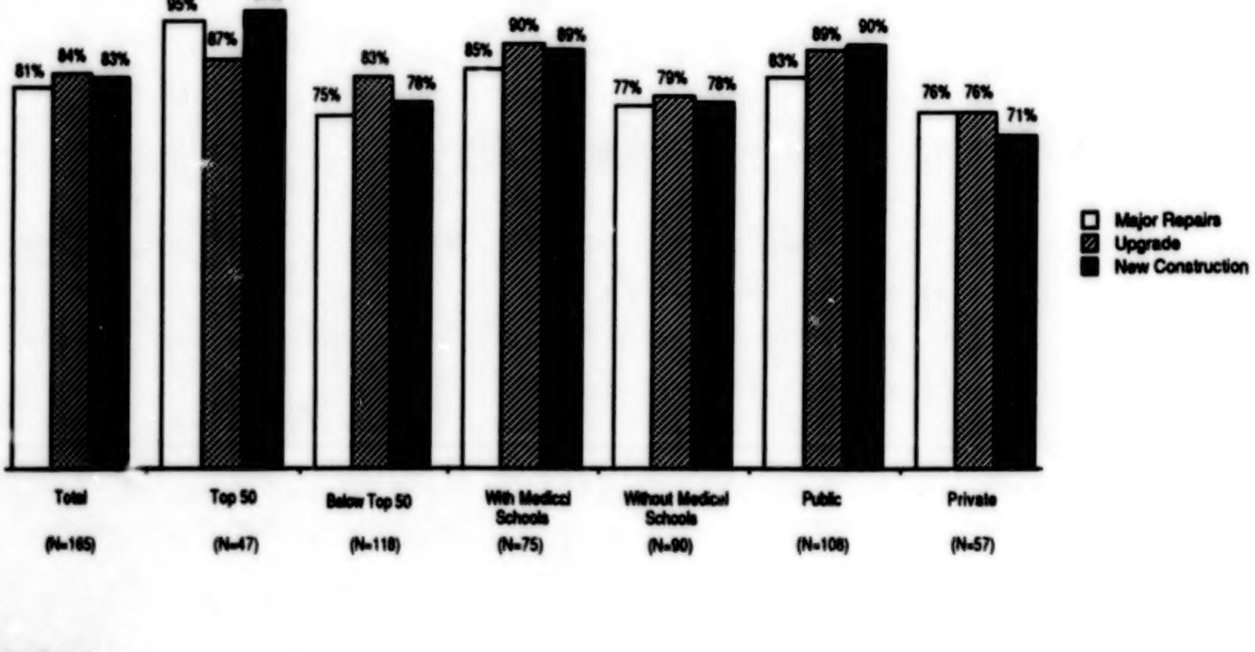
Almost three-fourths of the institutions indicated that **major repairs** associated with research facilities were in progress in academic year 1985-86; the average expenditure associated with these repairs was about one million dollars. As with other expenditures on facilities, there was a striking difference between top 50 schools and others: 90 percent of the former had major repairs in progress, compared with 68 percent of the others. In addition, the top 50 schools were spending more than twice as much on major repairs as other universities, averaging $1.6 million dollars compared to less than $700,000 for the others. Private universities spent more on repairs than public universities.

Planned Work: 1986-1991

Over 80 percent of all universities had facilities work planned in the next five years. Top 50 schools, universities with medical schools, and public institutions were more likely to have facilities-related expenditures planned (Chart 4). The average expenditure budgeted for the planned work was also higher among top 50 schools and universities with medical schools.

Over 80 percent of the universities planned to **construct new research facilities** in the next five years. The average estimated expenditure for this construction was about $32.5 million (Appendix Table A-2). Top 50 schools projected amounts which are about three times those of other institutions, and universities with medical schools also projected somewhat higher expenditures than others. Public universities were more likely than private universities to have new construction planned; however, private universities planned to spend more, on average.

Chart 4. Universities Reporting Facilities-Related Planned Work, 1986-1991



Reference: Table 4
Source: National Science Foundation

About 84 percent of the universities also planned to **upgrade** or **renovate** existing facilities over the next five years, spending an average of about $11 million. Again, top 50 schools estimated expenditures substantially higher than others. Universities with medical schools projected spending for upgrading and renovation during the next five years that was over four times greater, on average, than that of universities without medical schools. Private universities also reported average expenditures somewhat higher than public universities.

Just over three-fourths of the universities in the survey planned **major repairs** of existing research facilities in the next five years; the average expenditure associated with these repairs was $5.4 million. The top 50 schools projected spending that was more than two and one-half times greater than that planned by other universities -- $9 million compared to $3.4 million. Universities with medical schools planned a 28 percent lower average expenditure on repairs than those without medical schools. The average expenditure projection was about 45 percent higher for private than public institutions.

Sources of Funding for Research and Development Facilities

Respondents assigned the proportions of the costs associated with facilities repairs, upgrading and construction to four selected sources: the Federal government, the state budget (excluding the university's normal operating budget), tax-exempt bonds, and private donations or endowments. Based on these percentages and dollar amounts provided for each category of work, the distributions of facilities-related costs were calculated.

As would be expected, public universities relied more on state funds and private universities relied more on donations or endowments to finance facilities expenditures. Public institutions received at least half of their funds from the state; private institutions received over a third of their funds from private endowments.

In general, top 50 schools also relied more heavily on private donations than did other institutions, despite the fact that the majority are public institutions. Tax-exempt bonds financed at least 25 percent of the new construction in progress and planned across all universities.

The following sections separately describe the sources of funds for work in progress and planned in each category -- new construction, upgrading and renovation, and major repairs.

Work in Progress: 1985-86

State governments accounted for the highest proportion (40 percent) of **new construction** funds (Appendix Table A-3). Tax-exempt bonds furnished 30 percent of new construction costs; private donations, 14 percent. The proportion of funds obtained from Federal sources (10 percent) was about the same for new construction as for repairs and upgrading or renovation (Chart 5).

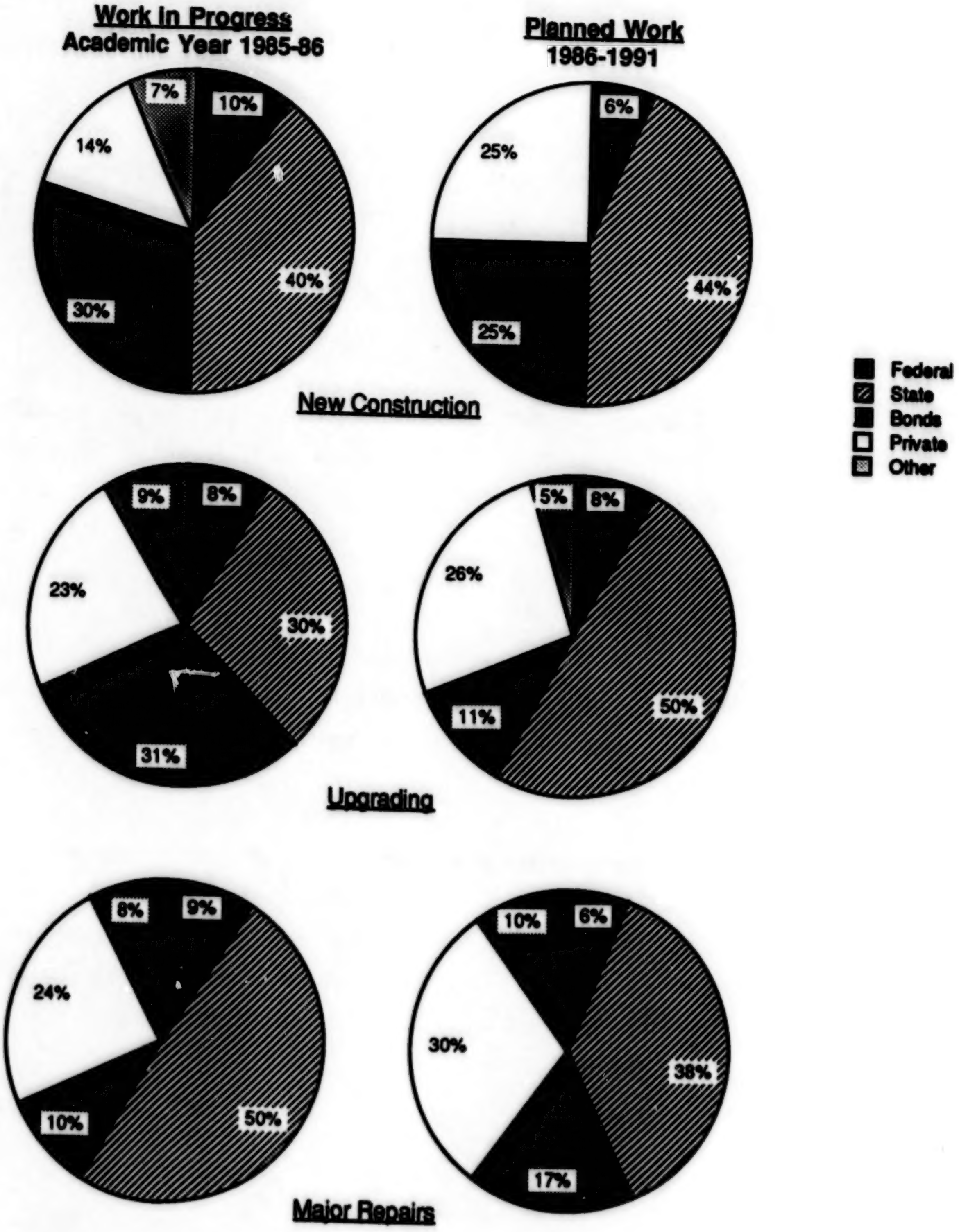
State governments and tax-exempt bonds each provided almost one-third of the costs for **upgrading and renovations** in progress. Just less than a quarter of these costs, as well as those of major repairs, were financed by private donations. State governments provided half of the funds for **major repairs**.

Thirty-five percent of the **new construction** in progress at private institutions was financed with Federal funds compared to less than one percent at public institutions (Chart 5a). Private universities also received 29 percent of their new construction funds from private donations and endowments; public universities received only 9 percent from that source. The major sources of funds for new construction at public universities were state governments (53 percent) and tax-exempt bonds (35 percent).

Planned Work: 1986-1991

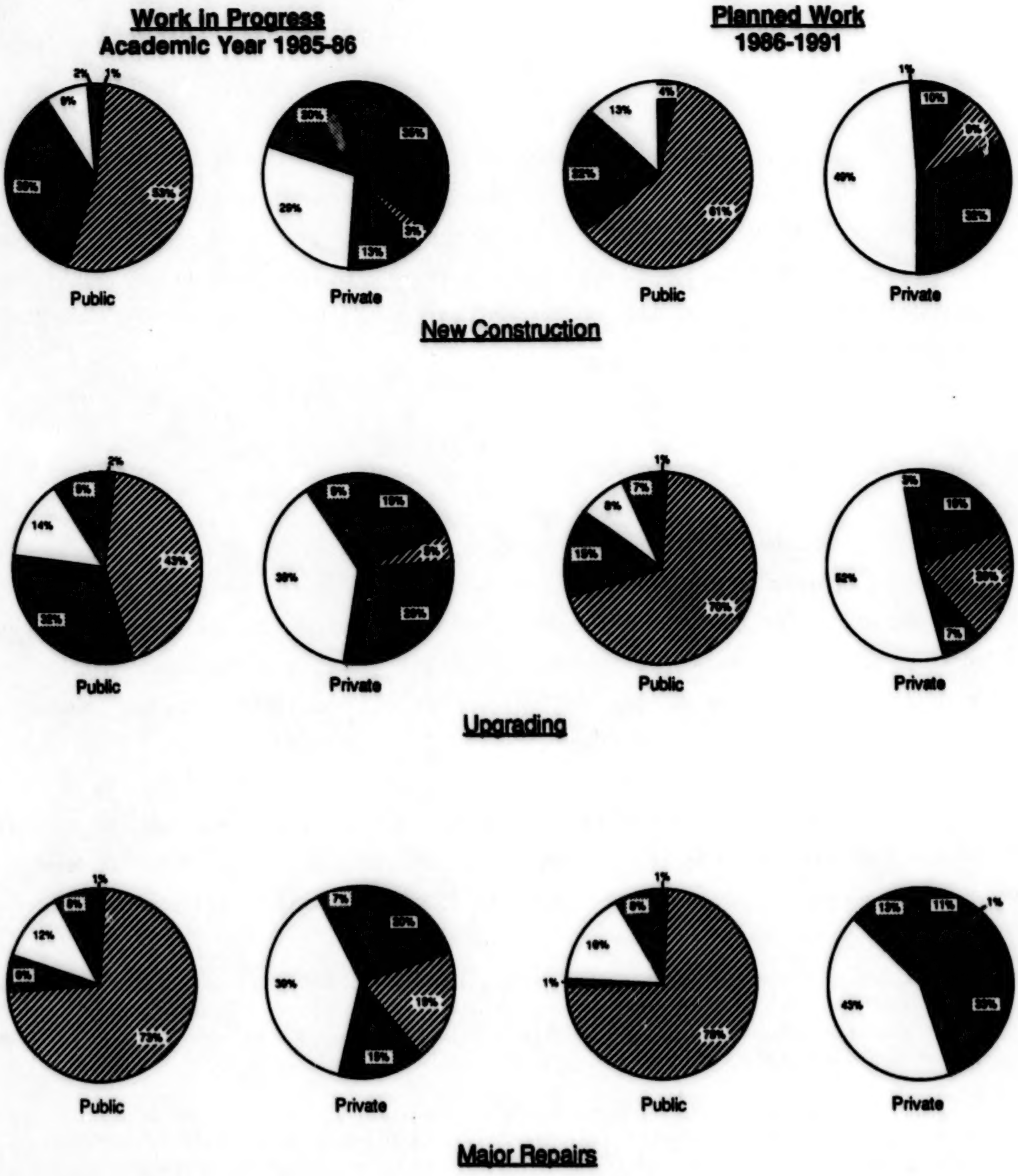
All universities anticipate less Federal money for **new construction** in the next five years. Private sources, and to a lesser extent, state governments, are expected to compensate for

Chart 5. Sources of Funding for Facilities-Related Work: All Universities



Reference: Appendix Table A-3 and A-4
Source: National Science Foundation

Chart 5a. Sources of Funding for Facilities-Related Work: Public and Private Universities



■ Federal
▨ State
■ Bonds
□ Private
▨ Other

Reference: Appendix Tables A-3 and A-4
Source: National Science Foundation

decreases in Federal money. Universities also plan to use tax-exempt bonds more to finance repairs (Appendix Table A-4).[6]

Traditional sources are expected to provide larger shares of the costs of planned new construction at both public and private institutions. Over 60 percent of the costs at public universities will be supplied by state governments; over 40 percent of the costs at private universities, by donations and endowments. When compared to work in progress, private universities will generally rely more on tax-exempt bonds to finance planned work, while public universities will rely less on that source.

Age of Research and Development Facilities

To further describe current academic research facilities, universities were asked to report the proportion of their research-related facilities which were constructed or renovated in five selected time periods.[7] Early discussions with academic officials had suggested that the condition of facilities roughly corresponded to their age. Analysis of the information obtained in these surveys indicated that age was only a gross, and sometimes misleading, measure of condition.

Roughly 43 percent of academic research facilities were constructed or renovated between 1970 and 1986 (Chart 6). On the average, the universities reported that 18 percent of their facilities were built or renovated since 1980; 25 percent during the 1970s, about 30 percent in the 1960s; about 15 percent in the 1940s and 1950s, and about 12 percent before 1940 (Appendix Table A-5).

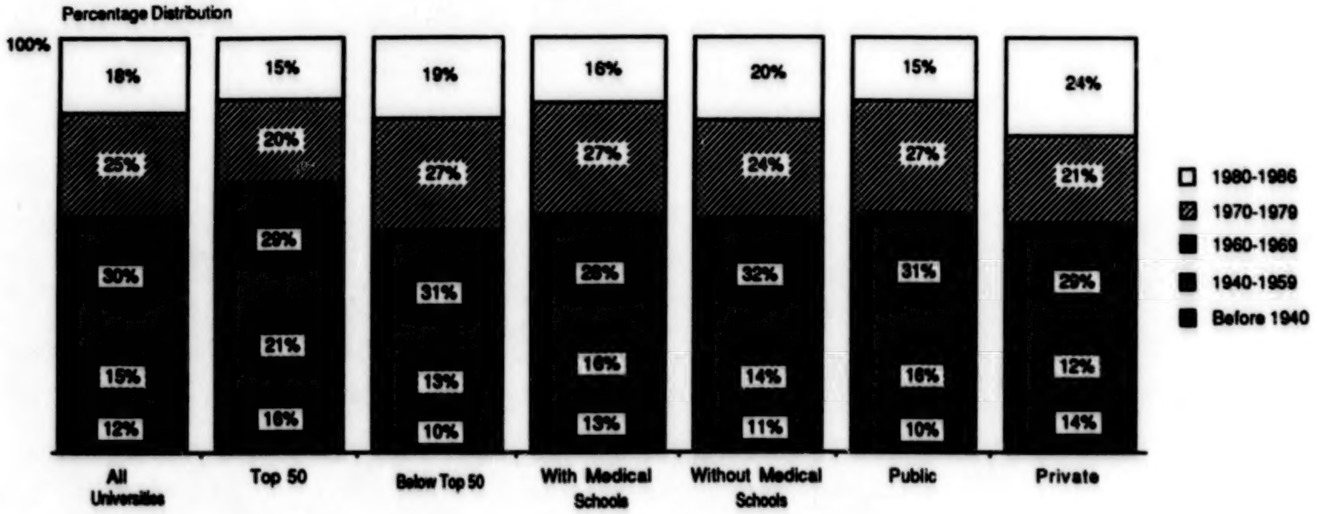
---

[6] Some institutions, while they were able to project building costs, could not report the sources of their future building funds; this information is sometimes not known until the funding for a given project is actually "packaged." For this reason, not all universities could provide information on the sources of funding for future construction. These respondents are not included in Appendix Table A-4.

[7] Some institutions were unable to identify the date of facilities renovations, so they responded based on construction dates. Furthermore, when asked about the age of research facilities, about 85 percent of the institutions reported the age of buildings that house research space, not the age of research space, per se. Nonetheless, when these responses were compared with those from the institutions that did report the age of research space, the age distributions were similar. See the Technical Notes (Table 4) for a comparison of the age distributions.

The top 50 schools reported somewhat older facilities than other institutions on average. This finding is consistent with the fact that the top 50 schools, in general, were founded earlier than the others. Among top 50 schools, 65 percent of their facilities were built or renovated prior to 1970, compared with 54 percent for others.

Chart 6. Average Proportion of Facilities Built or Renovated* in Selected Time Periods



*Some institutions were unable to identify the date of facilities renovations, so they responded with construction dates.

Note: Percents may not add to 100 because of rounding
Reference: Appendix Table A-5
Source: National Science Foundation

Section 2: Assessment of Academic Research Facilities

Introduction

In general, research administrators at universities with greater research and development expenditures were more likely to report having facilities in good or excellent condition in spite of the fact that their facilities are generally older than those at other schools. In addition, universities characterized as having facilities in good or excellent condition tended to have more research space. These schools were also more active in maintaining their research facilities and building new ones.

According to both research administrators and deans, facilities funding is viewed as a "marginal" expense relative to personnel and equipment. That is, expenditures for facilities improvement or expansion is most likely to increase when new funds are available and most likely to decrease when funds are cut. Both research administrators and deans were asked to place a priority on facilities needs relative to personnel and equipment needs. In general, they agreed that personnel was the last area where new funds would be added; however, personnel was also the last area that would be reduced if there were cuts. Equipment purchases were ranked between facilities and personnel.

These findings are based on telephone interviews with 80 research administrators and 175 deans at 81 doctorate-granting institutions. While the research administrators responded for the university as a whole, the deans spoke to the needs of 318 programs in nine specific areas including engineering, physical, environmental, mathematical, computer, life, medical, and social sciences, and psychology.[8]

The following sections present the findings from these interviews. The first two sections describe and compare research administrators' and deans' assessments of the quality of research space and the effects of facilities on research capabilities, as well as their perceptions of the problems in addressing facilities needs. The final section summarizes and contrasts the responses of research administrators at top 50 and other schools as well as the responses of research administrators at public and private institutions. This section also compares information for universities with facilities in good and fair condition, according to their research administrators, regarding research space, facilities-related work in progress and planned, and age of facilities.

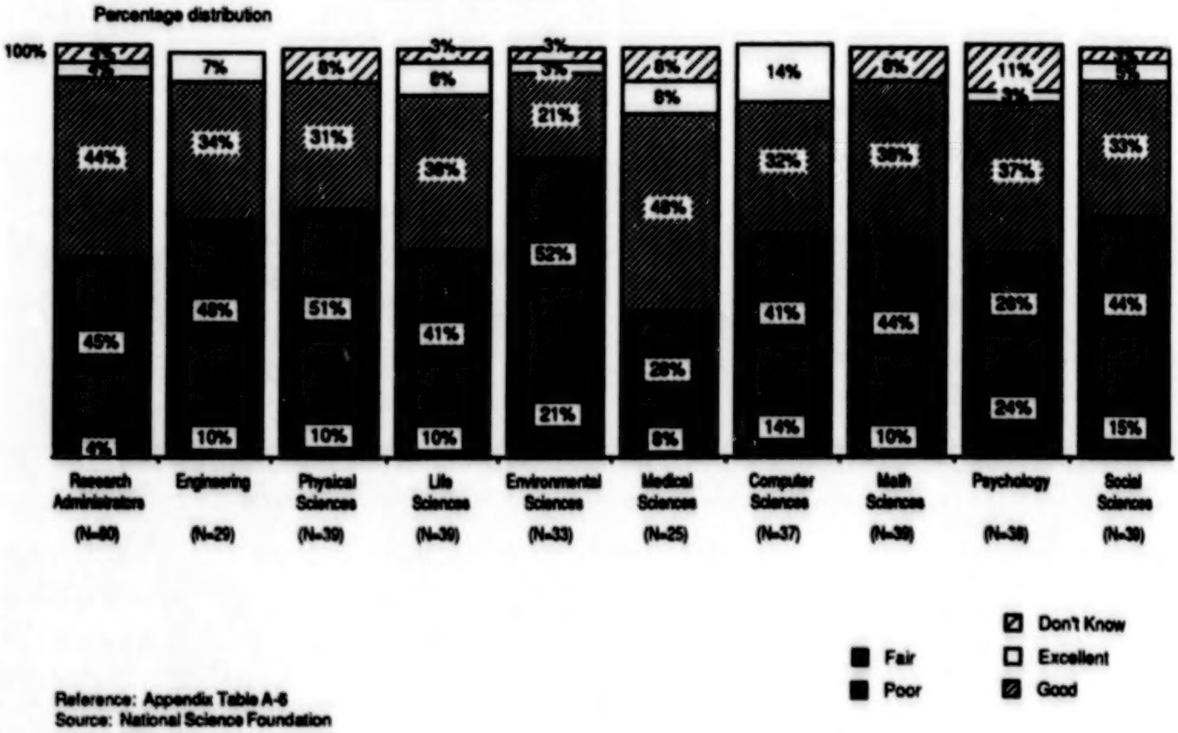
---

[8] About 40 deans addressed each area, except engineering and medical sciences, where the number of respondents was less than 30 because fewer institutions had engineering and medical schools. Furthermore, the distinction between areas is somewhat blurred. For example, some institutions reported on biochemistry as a medical science, while others reported it as a life science.

Research Administrators

The general impression of research facilities needs created by the research administrators' comments is that the lack of space is a more pressing problem than the quality of the existing space. In addition, concern regarding research space was often expressed in the context of its effect on the recruitment and retention of research personnel.

Chart 7. Academic Officials' Opinions Regarding Condition of Research Facilities



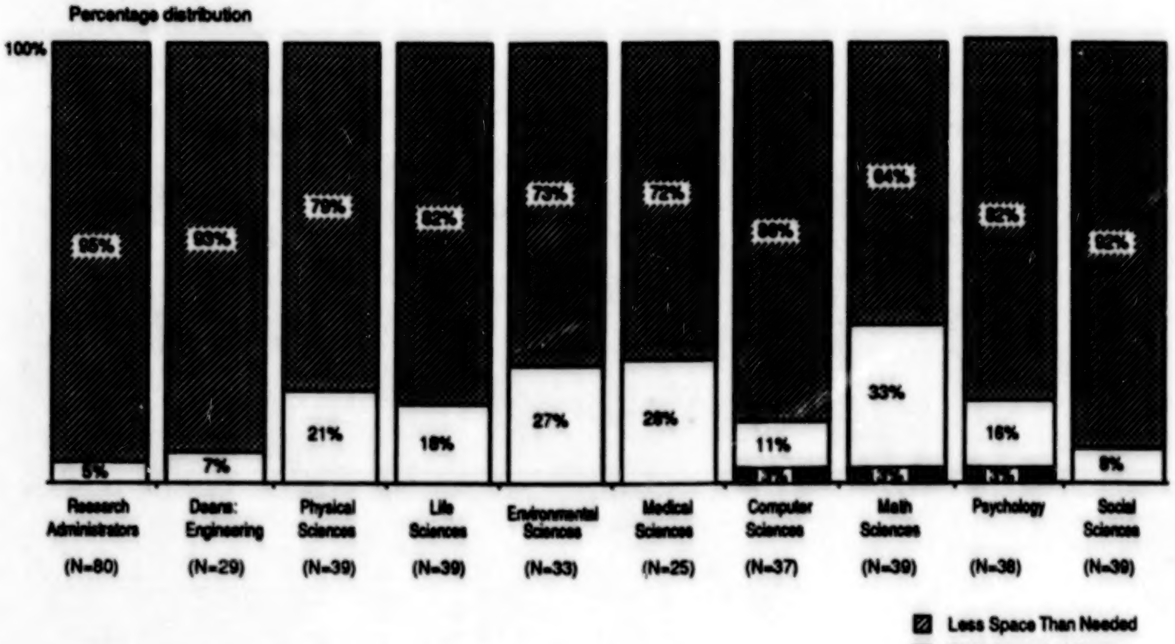
Reference: Appendix Table A-6
Source: National Science Foundation

When asked to characterize the **condition of research** facilities on their campuses (Appendix Table A-6), most of the eighty research administrators said that research space was in good or fair condition. Only three of the eighty said that research facilities were excellent, and only three said they were poor (Chart 7).

When asked about the **amount of research space** on their campuses, almost all of the research administrators agreed that there was less space than needed (Chart 8). Three-quarters of them said that additional research space was a more critical need than upgrading or repairing existing space (Chart 9). Several officials mentioned that space constraints split research groups or forced researchers off campus (Appendix Tables A-7 and A-8).

When asked whether they considered facilities, **"bricks and mortar,"** to be the **most pressing problem** facing research on their campus in the next five years, about a third of the

Chart 8. Academic Officials' Assessment of Sufficiency of Research Space



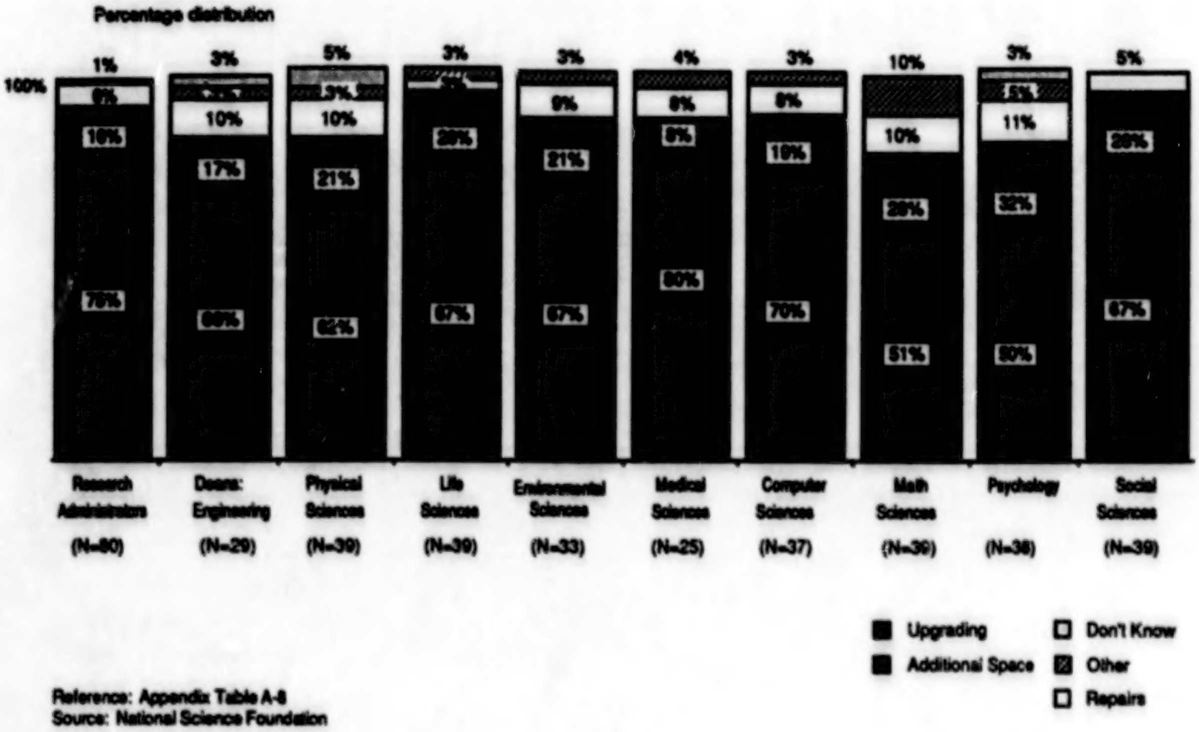
Reference: Appendix Table A-7
Source: National Science Foundation

research administrators said yes (Appendix Table A-9). Another 28 percent said that attracting and keeping high quality researchers, faculty, postdoctorates, and graduate students at the universities were more pressing problems than facilities.

The responses of the research administrators suggested that facilities funding is a marginal expense relative to personnel and equipment. When asked whether additional unrestricted research funds would be spent first on personnel, equipment, or facilities, 56 percent said the funds would be spent on facilities (Appendix Table A-10). A slightly larger percentage (64 percent) said that facilities improvement and expansion would be cut first, if there was a reduction in research support.

The scientific areas most frequently identified by research administrators as having significant facilities needs included biotechnology, engineering, and biomedical, biological and physical sciences. In addition, a number of officials mentioned the need for animal research laboratories.

Chart 9. Academic Officials' Identification of Most Critical Research Space Needs



Reference: Appendix Table A-8
Source: National Science Foundation

Over 80 percent of the research administrators said that facilities needs limited both the number and types of research projects carried out on their campuses as well as diverted funds from other uses (Chart 10). In addition, about 30 percent of the respondents volunteered that space constraints restricted their ability to attract and keep high quality researchers, faculty, postdoctorates, and graduate students (Appendix Table A-11).

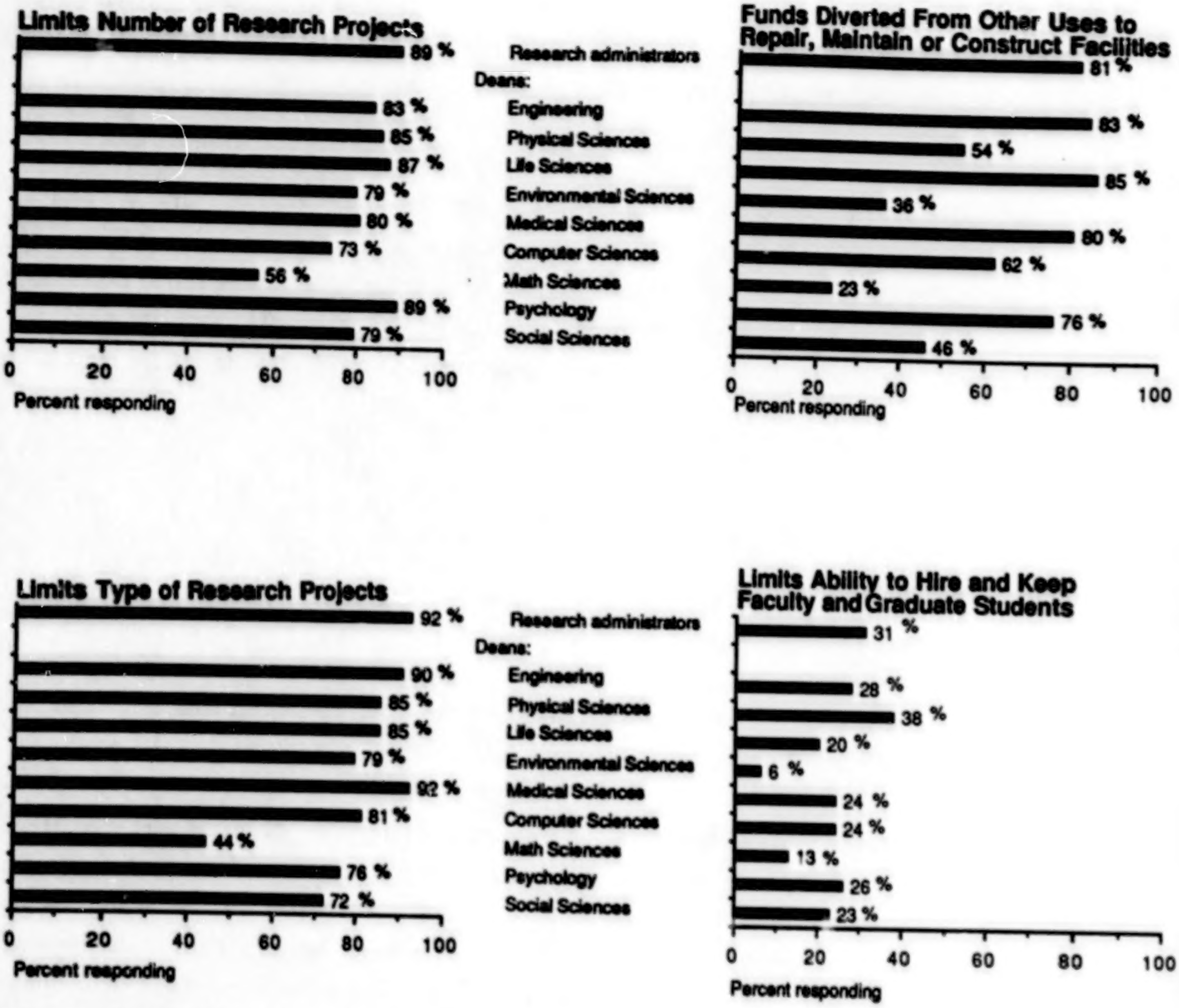
A majority of the research administrators said that the following **did not** constrain their university from addressing its facilities needs: inability to obtain loans, restrictions on the use of endowments and grants, legal restrictions such as government regulations and zoning laws, lack of campus space, and pressure to develop teaching rather than research capability (Chart 11). Nonetheless, 48 percent of the research administrators said that restrictions on grants and endowments were a problem and 38 percent said that lack of campus space inhibited them from solving their facilities needs (Appendix Table A-12).

Deans

The deans' comments generally supported the research administrators' view of facilities needs. A majority agreed that additional space was a more pressing problem than the condition of existing space. In addition, like the research administrators, when asked whether they considered facilities to be the **most pressing problem** facing research on their campus in the next five years at least one-third of the deans in most areas said yes (Appendix Table A-9).

However, more often than the research administrators, the deans expressed their concern about research space in the context of its effect on their ability to get and keep high quality researchers. In two areas, over half of the deans volunteered that the most pressing problems facing research in the next five years were **personnel related**. Further, deans were consistently less likely than research administrators to use additional research funds to improve or expand facilities, although they were usually somewhat less likely to make reductions here first.

Chart 10. Academic Officials' Assessment of Effects of Research Facilities Needs



Limits Number of Research Projects

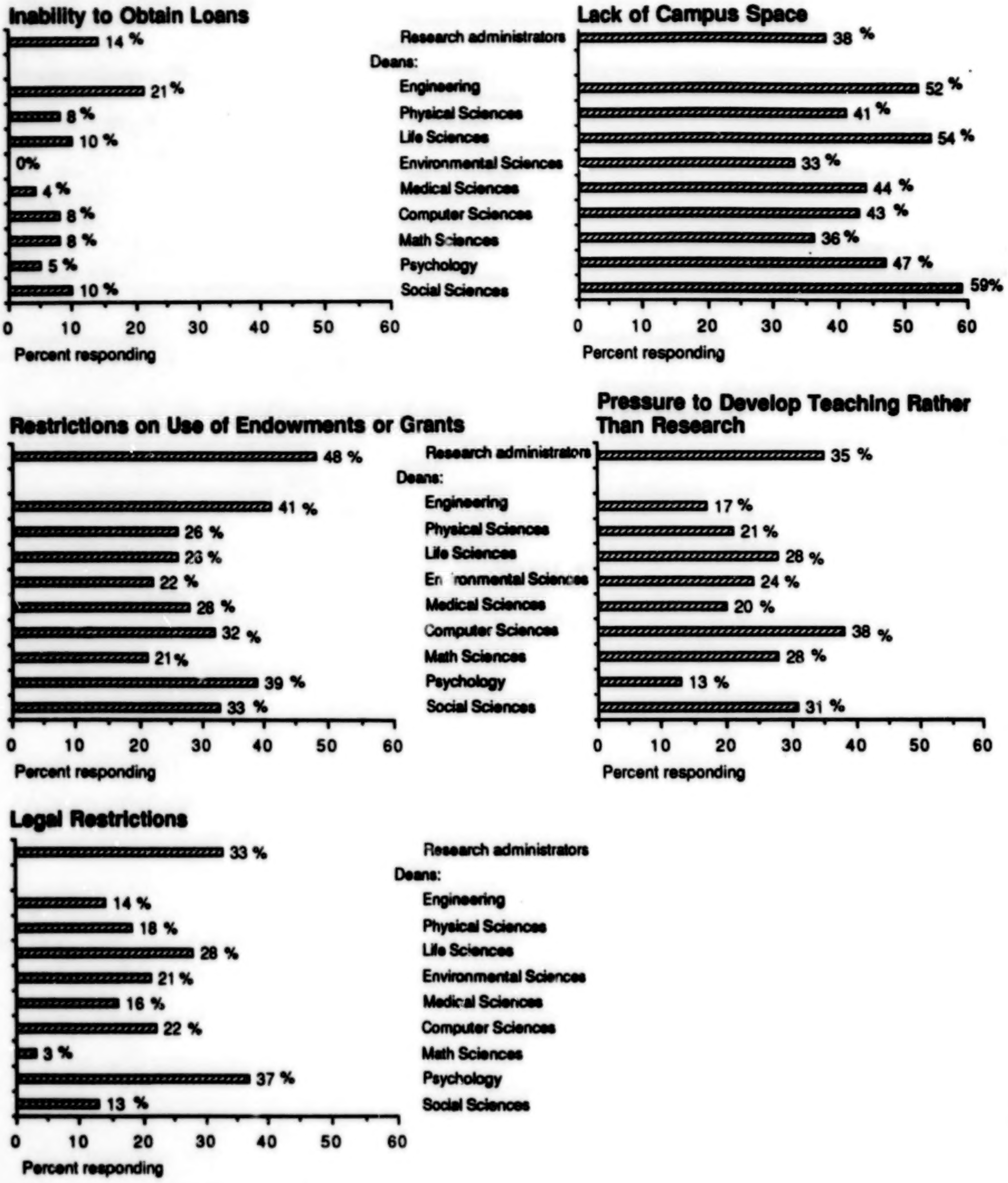
Funds Diverted From Other Uses to Repair, Maintain or Construct Facilities

Limits Type of Research Projects

Limits Ability to Hire and Keep Faculty and Graduate Students

Reference: Appendix Table A-11
Source: National Science Foundation

Chart 11. Academic Officials' Opinions About Problems Addressing Facilities Needs



Reference: Appendix Table A-12
Source: National Science Foundation

In all areas, over 60 percent of the deans said that they had less research space than needed on their campuses (Appendix Table A-7), and a majority said that additional space was a more critical need than improving the quality of existing space (Appendix Table A-8). Nonetheless, deans were generally more likely than research administrators to say that upgrading and repair were critical needs; just as they were more likely to characterize the **condition of existing space** as poor (Appendix Table A-6).

In general, deans were less likely than research administrators to say that facilities needs limited projects and diverted funds, or to volunteer that these needs restricted their ability to attract and keep high quality researchers, faculty, postdoctorates, and graduate students. Still, a majority of the deans in most areas agreed that facilities needs limited projects and diverted funds (Appendix Table A-11).

A majority of the deans agreed with the research administrators that they were not constrained in addressing facilities needs by inability to obtain loans, restrictions on the use of endowment and grants, legal restrictions or pressure to develop teaching rather than research capability (Appendix Table A-12). Nonetheless, in most areas a greater proportion of the deans said that **lack of campus space** hindered efforts to address facilities needs.

Institutional Differences

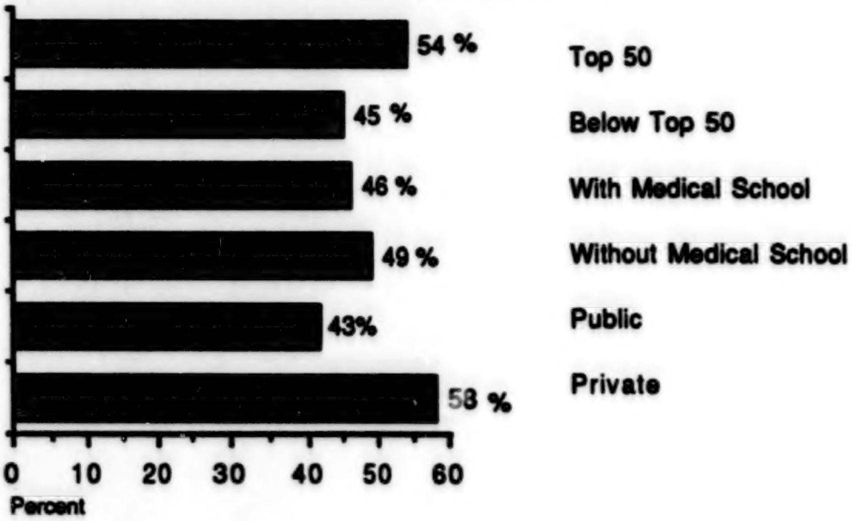
On average, research administrators at universities with greater research and development expenditures rated the condition of their facilities as better. A majority (54 percent) of the research administrators representing top 50 schools characterized the condition of their facilities as good or excellent compared to 45 percent of the research administrators at other institutions (Chart 12). Research administrators at private universities were also more likely than those at public schools to rate facilities as good or excellent (58 percent compared to 43 percent).

While, in general, the research administrators' comments suggested that quantity of space was a greater problem than quality of space, additional space was a more pressing need for schools ranked below the top 50. Ninety-six percent of the research administrators representing these schools said they had less research space than they needed, and 80 percent of

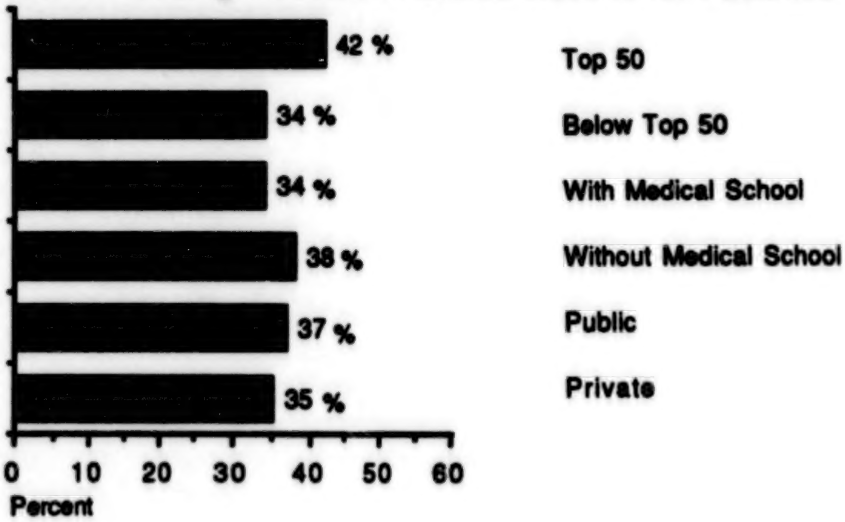
Chart 12. Research Administrators' Assessment of Facilities' Condition and Need

Percent Saying:

Condition of Facilities Good or Excellent



Most Pressing Research-Related Need is for Facilities



Reference: Appendix Tables A-13 and A-15

Source: National Science Foundation

them said that additional space was a more critical need than repairing or renovating existing space (Appendix Tables A-14 and A-15). In contrast, while 92 percent of the research administrators at the top 50 schools said they had less research space than needed, only 63 percent said that additional space was their most critical space-related need.

Nonetheless, if given additional research funds, research administrators at top 50 schools were more likely than others to use the funds to expand and improve facilities (63 percent compared to 54 percent; Appendix Table A-16). In addition, a larger proportion of the research administrators from top 50 schools (42 percent compared to 34 percent) said that facilities needs were the most pressing problems facing research on their campus in the next five years.

These responses are consistent with the finding that facilities funding is a "marginal" expense relative to personnel and equipment (that is, more likely to increase with additional funds and more likely to decrease with a reduction in funds); institutions with more research and development expenditures are more likely to fund marginal activities. Research administrators from schools with less research and development expenditures were more likely to say they would use additional funds for personnel (20 percent compared to 8 percent of the research administrators from top 50 schools).

Most research administrators said that facilities needs constrained their research efforts. Nonetheless, research administrators at top 50 schools were less likely than those at schools ranked below the top 50 to say that facilities limited the types of research projects carried out and diverted funds from other uses to maintain facilities. (Appendix Table A-17.) Compared to research administrators at public universities, those at private universities were less likely to say that facilities limited research projects, but they were more likely to say facilities needs diverted funds from other uses.

When asked about their problems addressing facilities needs, research administrators at top 50 schools were less likely than others to say lack of campus space was a problem (29 percent compared to 41 percent). Relative to other universities, more important problems for top 50 schools were inability to obtain loans, restrictions on the use of grants and endowments, and legal restrictions (Appendix Table A-18).

The fact that a larger proportion of top 50 schools are private (42 percent compared to 32 percent of those ranked below the top 50) probably explains the differences in the research administrators' assessments of the problems in addressing facilities needs. Compared to public universities, private universities generally depend more on endowments and private donations to finance facilities-related work (Appendix Tables A-3 and A-4). Furthermore, top 50 schools, both public and private, depended more on endowments and private donations to finance work on facilities

Sixty institutions with research facilities in either good or fair condition, according to their research administrators, also provided quantitative information about their facilities. The remainder of this section describes the differences in research space, facilities-related activities, and age of facilities between the institutions in the two categories.

Universities said to have facilities in good condition tend to have more research space than those with facilities in fair condition. The institutions characterized as having facilities in good condition by their research administrators had about 1.7 times more square footage devoted to research than did those with facilities characterized as being in fair condition.

Universities characterized as having facilities in good condition were more likely to have work in progress than those with facilities considered to be in fair condition. About 96 percent of the former had work in progress compared to 78 percent of the latter. In addition, universities with facilities characterized as in good condition were slightly more likely to have work planned.

The average estimated cost to complete renovations in progress and renovations and repairs planned were higher for those institutions with good facilities. Universities characterized as having facilities in fair condition by their research administrators anticipated spending more, on average, for new construction, both in progress and planned, and for repairs in progress (Table 3).

Universities characterized as having good facilities have a larger proportion of facilities built, or renovated, before 1960 than schools with facilities considered to be in fair condition (28 percent compared to 22 percent).

Table 3. Average Cost of Facilities-Related Work by Condition of Facilities

	Research Administrators' Assessment of Conditions	
	Good	Fair
Work in Progress: 1985-86		
Major Repairs		
No. of Institutions	22	16
Average Cost (in thousands)	$842	$1,226
Upgrading or Renovation		
No. of Institutions	21	17
Average Cost (in thousands)	$3,391	$2,868
New Construction		
No. of Institutions	19	16
Average Cost (in thousands)	$13,969	$14,106
Planned Work: 1986-1991		
Major Repairs		
No. of Institutions	22	18
Average Cost (in thousands)	$6,883	$4,165
Upgrading and Renovation		
No. of Institutions	20	17
Average Cost (in thousands)	$12,277	$11,379
New Construction		
No. of Institutions	25	21
Average Cost (in thousands)	$34,080	$37,253
Number of Institutions	30	30

Section 3: Assessment of Academic Research Facilities in Specific Areas

Introduction

Needs for facilities in engineering, and medical, life, and physical sciences appear to dominate the overall assessments of research space by academic officials. Current and planned construction are concentrated in these four areas (Chart 13). In terms of campus-wide facilities needs, research administrators most frequently cited biological, biomedical, and physical sciences, engineering, and biotechnology as the most significant areas.

To supplement and expand the research administrators' assessments of facilities needs, deans responsible for nine broad science and engineering areas were asked to assess the condition of research space under their purview and to describe the unique facilities needs in their areas. In general, deans representing physical and environmental sciences were more likely than others to consider "bricks and mortar" to be the most pressing research-related problem in the next five years (Appendix Table A-9). About half of these deans considered facilities to be the highest priority problem. Moreover, a larger proportion (over 60 percent) of the deans representing these two areas also characterized the condition of their research facilities as fair or poor (Appendix Table A-6).

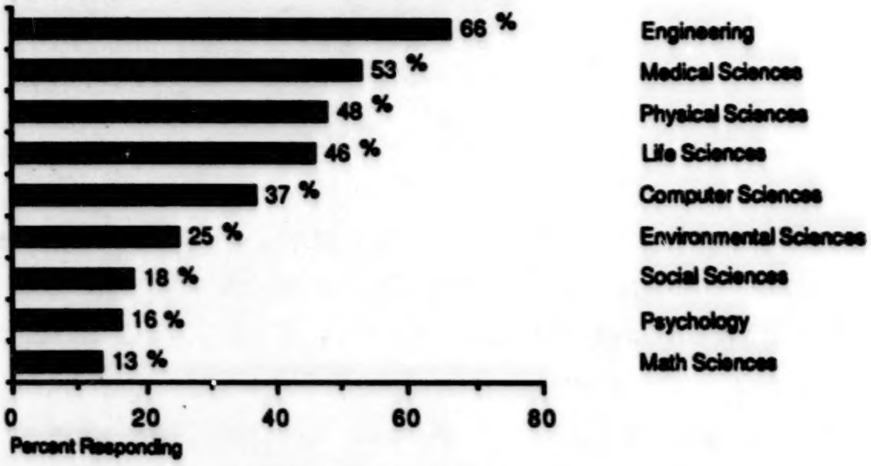
The relatively poor condition of facilities in environmental and physical sciences may be attributable to age. Facilities in these two areas, as well as social sciences, are relatively old compared to most other areas (Chart 14).

Information on the age of oldest and newest facilities in nine science and engineering areas was obtained from over 150 higher education institutions. From these data, age distributions were computed for each area and the median ages of oldest and newest facilities were calculated (Appendix Table A-19). In general, those areas in which there were more older facilities also had more new facilities.

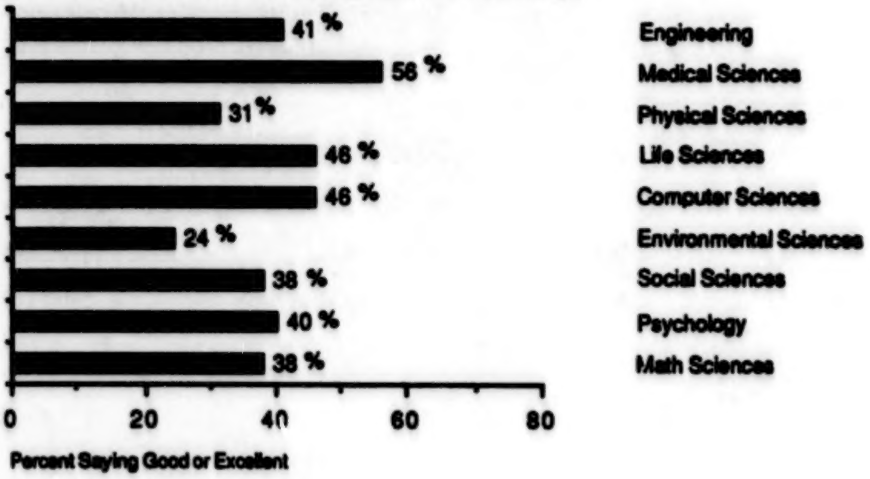
Fewer deans representing social and mathematical sciences considered facilities a pressing problem, although over 50 percent of them characterized the condition of their research space as only fair or poor. In addition, fewer deans representing these two areas indicated that

Chart 13. Facilities Construction Activities and Deans' Assessments of Facilities Condition and Need

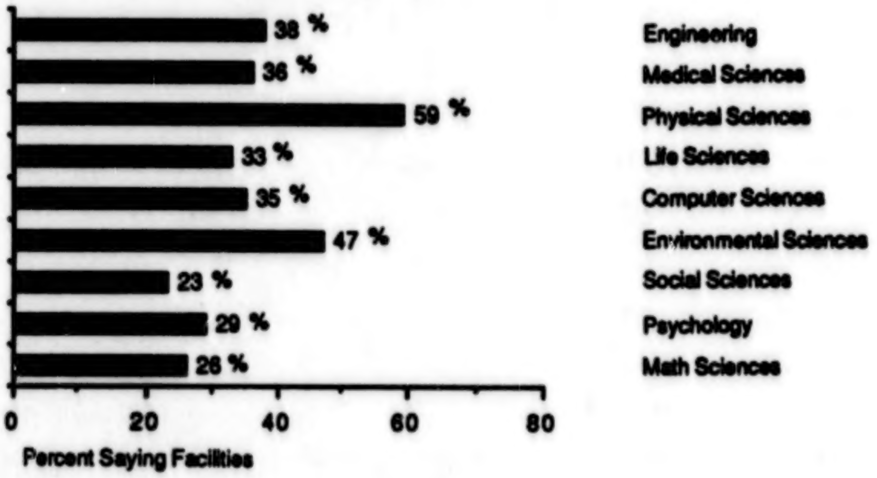
Institutions Reporting New Construction in Progress or Planned



Deans Assessment of Condition of Facilities



Deans' Assessment of Major Problems Facing Research in the Next Five Years



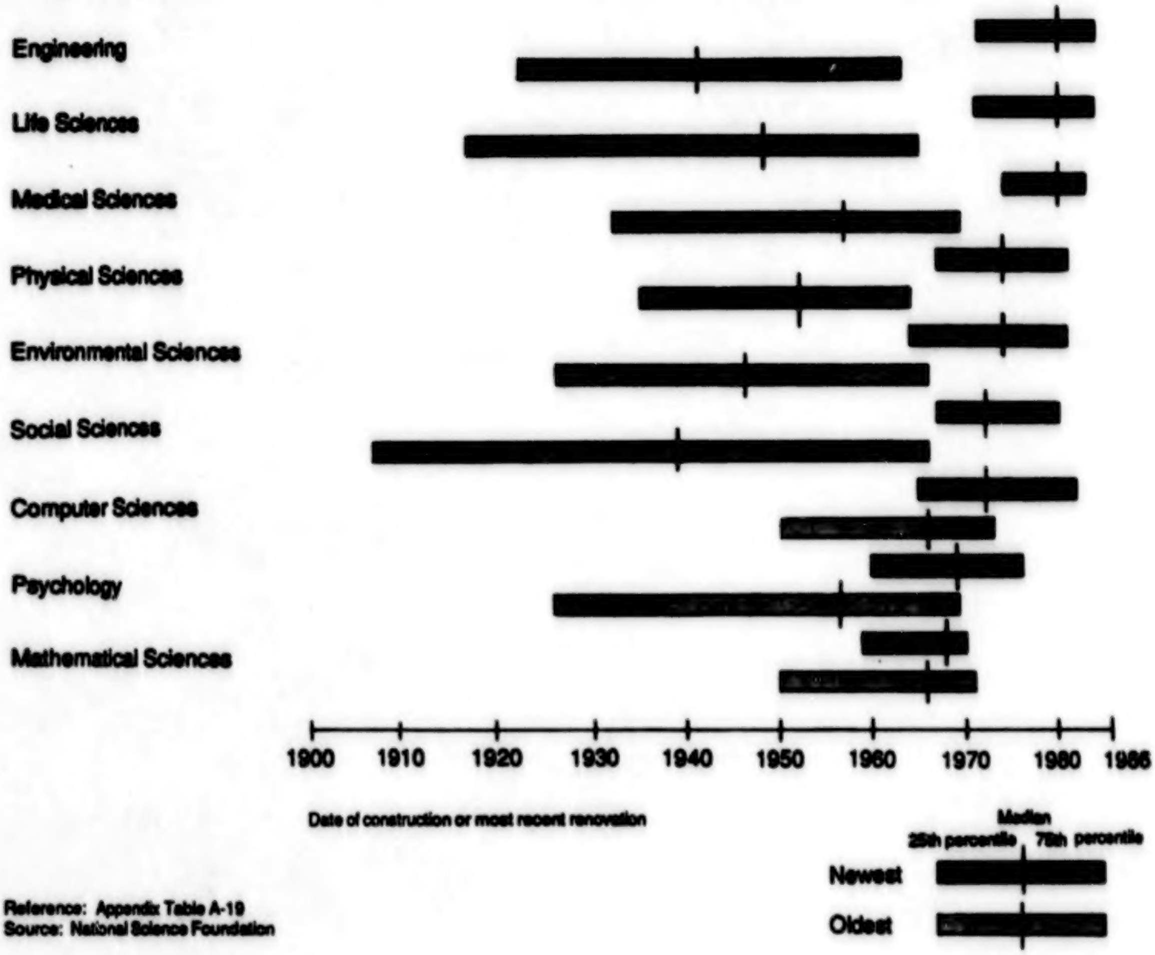
Reference: Appendix Tables A-6 and A-9
Source: National Science Foundation

facilities needs limited the number and types of projects they could carry out or diverted funds from other areas (Appendix Table A-11).

Among the deans, those representing medical sciences were most likely to say that the condition of facilities under their purview was excellent or good; in fact, this was the only area in which a majority of the deans said that facilities were in better than fair condition. Deans representing the medical sciences were also most likely to report that additional space was their most critical need with respect to research space, although 28 percent of them said they currently had about the right amount of space (Appendix Table A-11).

Deans representing engineering and social science were most likely to report that they had less research space than they needed. However, this assessment is likely to change in

Chart 14. Age Ranges of Newest and Oldest Research Facilities



Reference: Appendix Table A-19
Source: National Science Foundation

engineering, at least; two-thirds of the 130 universities with engineering schools were currently building facilities in this area, or were planning to do so (Chart 13). When asked whether facilities, equipment, or personnel would be cut first if research funds were reduced, engineering deans were least likely to report facilities.

When describing the **effects of facilities needs** on research in their areas, deans representing psychology and physical and life sciences were more likely to report that facilities limited the number of projects that could be done (Appendix Table A-11). Those deans representing medical sciences and engineering reported most often that facilities needs limited the types of projects and diverted funds from other uses. At least 20 percent of the deans in each area, except environmental and mathematical sciences, reported that facilities needs inhibit their ability to attract and keep qualified research personnel.

The following sections summarize 175 deans' perceptions of facilities conditions and needs in 318 programs in nine science and engineering areas. Each section profiles a specific area: engineering, physical, life, environmental, medical, computer, and mathematical sciences, psychology, and social sciences.

Engineering

Engineering is the area of greatest activity with respect to facilities construction. Two-thirds of the 130 institutions with engineering programs that were surveyed were building, or planned to build, engineering facilities in academic year 1985-86.

Evidence of substantial, recent construction activity is seen in the fact that one-half of the newest engineering facilities were built since 1980. Nonetheless, many older units are still in research use; almost half of the oldest facilities in this area were built since 1940.

A majority (58 percent) of the deans speaking for engineering characterized the **condition of facilities** as less than good. More (66 percent) said that additional space, rather than upgrading or repair of existing space, was the most critical space-related need.

With regard to the **amount of space** available, 93 percent of the engineering deans said that there was less than needed. One dean commented that a shortage of space demoralized faculty "due to continuous moving and crowding". Another remarked that "cramming too much into too little space had gotten in the way of multidisciplinary research that could be done with existing personnel".

The engineering areas with the most pressing needs included materials, biochemical and biotechnical engineering, and microelectronics and electrical engineering. Computer-assisted design/computer assisted manufacturing, robotics, and computer engineering were other areas mentioned by several deans.

The majority of those interviewed agreed that facilities needs limited the number and type of research projects that could be carried out (83 percent and 90 percent, respectively). In addition, 83 percent of the deans said that the repair, maintenance, and construction of facilities diverted research funds from other uses.

If additional research funds were available, 45 percent of the engineering deans would improve or expand facilities. In the case of a reduction in research support, 41 percent would reduce support for facilities improvement and expansion first.

When discussing the problems in addressing facilities needs, deans representing engineering were more likely than others to mention the unavailability of loans and restrictions on grants. Lack of campus space was another problem; one dean remarked that:

> In analyzing the facilities needs, one should take into account that NSF and other agencies are now sponsoring large interdisciplinary research projects such as the engineering research centers. These kinds of programs will require substantial additional space in the institutions where they are established. Furthermore, engineering education has changed dramatically in the last twenty-five years, from concentration on undergraduate teaching to a mix of undergraduate and graduate teaching and research. Many institutions have serious facilities shortages and faculty problems as a result of these changes.

Physical Sciences

Almost 60 percent of the deans representing physical sciences said that facilities needs were the **most pressing problem** facing research in the next five years, a larger proportion than in any other area. Moreover, 61 percent of the deans characterized the **condition** of physical sciences research space as only fair or poor.

Facilities in the physical sciences are relatively old compared to other science areas. Over half of the newest facilities were built before 1974; half of the oldest physical science facilities were built before 1953.

The **amount of space** was also a problem in physical sciences. About 80 percent of the deans said they had less research space than needed. Many mentioned that space constraints inhibited recruitment of faculty and graduate students. One dean said that lack of space was "removing some faculty from campus; a lot of people now choose to work part-time at [a nearby government laboratory]."

The areas of most pressing need were physics and chemistry, and many of the facilities needs were equipment-related. One dean said he needed "a place to house a telescope that NSF gave us money for ten years ago." Others mentioned needing laser laboratories, a space for a synchrotron, and "computer space; theoretical chemistry needs more space for computer graphics." They needed dust-free environments and wet lab space as well.

Over 85 percent of the deans representing physical sciences said that facilities limit both the number and type of research projects that can be carried out. Just over 50 percent said that the maintenance and construction of facilities diverted research funds from other uses; 38 percent of the deans said that facilities needs prevented them from attracting and keeping high quality researchers.

When asked about **problems in addressing facilities needs**, about 40 percent of the deans said lack of campus space was a problem. Over 20 percent said that restrictions on grants and endowments and pressure to develop teaching were constraints. Several deans cited the planning horizon for facilities construction as a problem; one dean said:

> The time it takes to develop, plan and construct facilities is a major problem. If you need one today and you can only build one in five to ten years, the problem may be gone before the facility is completed, and there will be another problem to take its place.

Despite the constraints, there is considerable **construction activity** in the physical sciences. Almost half of the universities surveyed were building or planning to build physical sciences facilities in academic year 1985-86.

Environmental Sciences

The condition of facilities in environmental sciences is worse than in other areas, according to the deans. When compared to the other eight areas, a higher proportion of the 33 deans speaking for environmental sciences (73 percent) said that the condition of their research facilities was poor or fair.

In addition, 47 percent of the deans said that facilities needs were the most pressing problems facing research in the next five years. This represents a higher proportion of the deans than in any other other field except physical sciences.

Within the discipline, the area most often cited as having significant facilities needs was geology, followed by atmospheric science, and meteorology. Several deans mentioned the need for remote sensing areas and computer facilities for analyzing land sensing data.

Facilities in environmental science are relatively old. Over half of the newest facilities were built before 1974; half of the oldest facilities were built or renovated before 1946. In addition, there is relatively little construction of new facilities occurring. Only a quarter of the institutions with environmental science programs reported that facilities construction was currently in progress or planned.

The amount of research space is considered to be a critical need. Among the deans, 73 percent said there was less space than needed; 67 percent said that additional space was the most critical space related problem in environmental sciences.

Reporting on the **effects of facilities needs**, almost 80 percent of the deans said that facilities limited the number or type of projects that could be carried out. Some deans mentioned that teaching programs as well as interdisciplinary research projects were hurt by space shortages. Despite the age and condition of their facilities, fewer deans speaking for environmental sciences said that the maintenance and construction of facilities diverted research funds from other uses when compared to deans in all other areas except mathematical sciences.

If additional research funds were available, 45 percent of the deans would use the money to improve or expand facilities. In the case of a reduction in funds, 64 percent of the deans would reduce support for facilities first.

One third of the deans said that lack of campus space prevented their institution from addressing its facilities needs in environmental sciences. A smaller number mentioned pressure to develop teaching rather than research capability, restrictions on use of grants, and legal restrictions as constraints. None mentioned that availability of loans was a problem.

Mathematical Sciences

Facilities were less a problem in mathematical sciences than in other areas, according to the deans, despite the fact that the condition is relatively poor. Only 38 percent of the deans characterized the condition of math science facilities as good; none said their condition was excellent.

Nonetheless, only 26 percent of the deans said that facilities were the most pressing problem facing mathematics research on their campus in the next five years. If given additional research funds, only 18 percent of the deans would improve or expand facilities.

According to the deans, attracting and keeping mathematicians are more important research-related issues. Over half of the deans volunteered that recruiting bright graduate students and high quality faculty are the most pressing problems facing mathematic research.

In general, space concerns relate to people, since there are no laboratory facilities in this area. A lack of office space is the most often cited facilities need. One dean said that the mathematics department was unable to make new appointments because there was no place to put the people. Another dean mentioned that he "couldn't locate mathematical scientists working on common problems in a common space." Others agreed that dispersion inhibited recruitment of faculty.

Over a third of the deans representing mathematical sciences said that they had at least enough research space; this was a larger proportion than in any other area. These deans were also more likely than most others to say that repairing and upgrading existing space was a more critical need than adding space. These attitudes probably explain the limited new construction in mathematical sciences. Only 13 percent of the 141 institutions with programs were building, or planning to build, math facilities.

While there are relatively few new buildings in mathematical sciences, there are also relatively few old ones. Half of the newest facilities were built since 1968 and half of the oldest facilities were built or renovated since 1966.

Facilities needs have fewer effects on research in mathematical sciences compared to other areas. Just over half of the deans said that facilities limited the number of projects that could be carried out; fewer (44 percent) said that they limited the types of projects. Fewer still (23 percent) said facilities needs diverted funds from other uses.

According to the deans, the areas with the most pressing facilities needs are applied mathematics, numerical analysis, and statistical computation. Most of the space needs are related to computers and personnel.

Computer Sciences

Deans representing computer sciences were more likely than those speaking for other areas to rate the **condition** of facilities as excellent. About 14 percent of them said computer science facilities were excellent on their campus. Another 32 percent said facilities were in good condition. The remainder characterized facilities as fair (41 percent) or poor (14 percent).

Most of the computer science facilities were built in the late 1960s. Half of the newest facilities were built before 1972; half of the oldest were built, or renovated, before 1966. There is a moderate amount of current construction activity in computer sciences; about a third of the 142 institutions with programs were building or planning to build research facilities.

In general, there is too little space in computer science. About 86 percent of the deans said they had **less space than they needed**, and 70 percent of them said that additional space was more important than repairing and upgrading existing space.

In general, space concerns in computer sciences are linked to personnel issues; office space is as much, or more, of a problem as research space. Many of the deans said that space constraints forced them to limit the number of students in the programs, hurt efforts to attract new staff, and restricted research and teaching programs. As one dean said: "We don't have enough space to set up experimental programs or hire people. We are frustrated in our efforts to attract top flight people."

More than in any other area, deans representing computer sciences said that personnel issues, attracting faculty and graduate students, were the most important problems facing research in the next five years on their campus. While 35 percent of the deans said facilities were more important, 59 percent said these personnel concerns were most pressing.

Only 38 percent of the deans would use additional research funds to improve and expand facilities. In general, equipment needs are more fundamental; as one dean said, "We are continually upgrading computers. If you don't upgrade, you quietly become obsolete." Another volunteered that universities can't compete with industry for doctoral computer scientists without updated equipment.

More deans (81 percent) said that facilities limited the types of projects that could be carried out than said that facilities limited the number of projects (73 percent). These responses were consistent with their appraisal of the areas of greatest need; artificial intelligence, robotics, networking, and computer graphics.

More than in the other areas, deans representing computer science said that they were constrained in their efforts to address facilities needs by pressures to develop teaching rather than research capabilities. Students drive the need for faculty, whose salary and equipment requirements absorb computer science funds. As one dean described the situation:

> The equipment and facilities have been scotch taped together. Institutions haven't had enough money to do it right, so what they've done is patched together, piece by piece, year by year.

Life Sciences

Life sciences facilities are in better condition that those in all other areas except medical sciences. Almost half of the deans surveyed said that the condition of life science facilities on their campus was good or excellent.

In part, the good condition is attributable to age. Half of the newest life science facilities were built since 1980. In addition, 48 percent of the 156 schools with life sciences are currently building, or planning to build, new facilities.

As in other areas, additional space is a critical need. Over 80 percent of the deans said that they had less space than they needed; two-thirds said that additional space was a more critical need than repairing and upgrading existing space.

The life science areas with the most pressing needs are biochemistry, biophysics, microbiology and plant biology, according to the deans. Several mentioned that the facilities needs at their campuses stem from a shift in emphasis toward research; teaching labs must be renovated to accommodate research.

Temperature control was a major facilities-related problem in the life sciences. One dean said that, due to limited space, the compressors were not able to work and the electrofluoridic gels could not be kept at the proper temperature. Another said "The biology building is not air-conditioned....In the summertime, in a hot spell, the temperature will get up into the nineties, which is not good for either the people or the processing equipment."

Over 80 percent of the deans said that facilities needs limited the number and type of projects that could be carried out in the life sciences, as well as diverting funds from other research areas to expand and improve research space. About a third of the deans said that facilities needs were the most important problem facing research on their campus in the next five years.

When asked whether they would spend additional research funds on facilities, personnel, or equipment, 49 percent of the deans said facilities. Nonetheless, 74 percent of them said that they would reduce facilities spending first, if there was a reduction in research funding.

When asked about their **problems in addressing facilities needs**, a majority of the deans said that lack of campus space prevented them from solving their research space constraints. Over a quarter of the deans mentioned pressure to develop teaching, restrictions on grants and endowments, and legal restrictions. The latter was cited as a problem in life sciences more often than in any other areas except psychology.

Medical Sciences

The condition of research facilities in medical sciences is better than in other science and engineering fields, according to the deans surveyed. A larger proportion of the deans representing medical sciences (56 percent) said that the condition of research facilities was excellent or good.

In general, medical science facilities are relatively new. Half of the newest facilities were built since 1979. In addition, there is considerable current construction activity in this area. Over 50 percent of the 111 universities with medical science programs were building, or planned to build, research facilities in academic year 1985-86.

Additional space is the most critical need with regard to research space in medical science according to 80 percent of the deans. Over 70 percent of them said that they had less space than they needed. Several deans mentioned the need to consolidate research space to avoid fragmentation and duplication of effort. One dean noted that current space constraints "tended to produce collaboration with hospitals which is not always in the best interests of research".

The areas of greatest need with respect to research space were neurobiology, molecular biology, and molecular genetics. In addition, several deans mentioned the need for clinical space, animal laboratories, and space for computers.

Over 90 percent of the deans reported that facilities needs limited the types of projects that could be carried out on their campuses. Eighty percent of the deans said that facilities limited the number of research projects in medical sciences and divert funds from other research areas to maintain and renovate space. Almost 25 percent of the deans mentioned that facilities needs inhibited them in attracting high quality researchers, graduate students and postdoctorates.

Lack of campus space was the most frequently cited problem in addressing medical sciences facilities needs. When asked how they would spend additional research funds, 44 percent of the deans said they would expand and improve facilities. If research funds were reduced, almost 70 percent of the deans would cut funds for facilities first.

About one third of the deans said that facilities were the most important problems facing medical science research on their campus in the next five years. Another third said that personnel-related problems, attracting and keeping high quality researchers, were more pressing.

Psychology

More than in any other area, deans representing psychology described the condition of facilities as poor. About 24 percent of them characterized facilities as poor, and another 26 percent characterized research space as only fair. The deans speaking for psychology described existing space as "decrepit," "obsolete," and "deteriorated."

Compared to other areas, **additional space** was less important in psychology. Only 50 percent of the deans cited additional space as their most critical space-related need, even though 82 percent had less space than they needed.

The relatively low priority placed on additional space may explain the low level of construction activity in psychology. Only 16 percent of the 148 institutions with psychology programs were building, or planned to build facilities in that area in academic year 1985-86.

Most of the facilities housing psychology programs were built in the 1960's. Half of the newest facilities were built before 1969 and half of the oldest were built, or renovated, after 1958.

Less than a third of the deans (29 percent) said that facilities needs were the most important problem facing psychology research on their campus in the next five years. Over 40 percent volunteered that recruiting and keeping qualified graduate students and faculty were their most pressing research concern.

Crowding and dispersion of faculty and researchers among several buildings were problems mentioned by several deans. One said:

> Faculty morale and interest is low and the ability to recruit graduate students constrained because the work in psychology is split in different buildings that are inadequate to meet the needs of the faculty.

Many deans representing psychology cited the need for better animal care facilities. Other areas with research space needs were clinical psychology and neuropsychology.

Facilities needs in psychology limit the number of projects that can be carried out on their campuses, according to 89 percent of the deans. A smaller proportion of the deans (76 percent) said that facilities limited the type of projects carried out and diverted funds from other research areas. About 25 percent of the deans said that facilities needs create personnel problems; as one dean volunteered:

> The facilities shortages limit enrollments of very bright and able research and doctoral students. We cannot recruit them and we cannot admit them.

More than in any other science area, deans representing psychology said that legal restrictions limited their ability to address facilities needs. Restrictions on grants were another important constraint, whereas pressure to develop teaching and availability of loans were relatively unimportant constraints.

When asked how they would spend additional psychology research funds, 45 percent of the deans said they would expand and improve facilities. If research funds were reduced, 61 percent of the deans would cut funds for facilities before reducing support for personnel or equipment.

Social Sciences

Facilities in the social sciences are generally older than those in all other areas. Half of the oldest social science buildings were constructed or renovated before 1940. Half of the newest facilities were built before 1972.

Moreover, the **condition** of social science facilities is relatively poor. Only 38 percent of the deans representing this area said that facilities were in better than fair condition; 15 percent said facilities were in poor condition.

When compared to other science areas (not engineering), a larger proportion of the deans representing social sciences (92 percent) said they had **less space than needed**. Two-thirds (67 percent) said that adding space was a more pressing problem than upgrading and repairing existing space. Nonetheless, there is relatively little construction activity in social sciences. Only 18 percent of the 147 institutions with programs were building, or planning to build, social science facilities.

Compared to all other areas, fewer deans speaking for social sciences (23 percent) considered facilities the **most important problem facing research** on their campus in the next five years. More deans (44 percent) considered personnel issues, recruiting graduate students and faculty, more important.

Facilities needs were concentrated in anthropology. In addition, several deans mentioned the need for computer space and computers in other social science areas, especially sociology.

Deans representing social sciences were slightly more likely to say that facilities needs **limited the number of projects** than that they limited the types of projects. Relatively few deans (46 percent) said that maintenance and repair of facilities diverted funds from other uses.

More than in any other area, deans speaking for the social sciences said that lack of campus space limited their ability to address facilities needs. Almost 60 percent of the deans said this was a problem.

TECHNICAL NOTES

This section provides a description of the methodology employed in the collection of data on research facilities in the National Science Foundation's (NSF's) survey of *Academic Science and Engineering Research and Development Facilities* and survey of *Research Administrators' and Deans' Perceptions of Research and Development Facilities Needs.*

The Samples

The universe for this study includes all doctorate-granting institutions participating in the Higher Education Surveys (HES) national panel. All of the institutions designated as doctorate-granting in the Department of Education Higher Education General Information Survey (HEGIS) were included in the national panel, with the exception of one which declined to participate in HES.

All of the 170 doctorate-granting institutions in the HES panel were included in the mail survey on *Academic Science and Engineering Research and Development Facilities.* A systematic sample of 85 institutions (50 percent of the population of doctorate-granting institutions) was selected for the telephone survey of *Research Administrators' and Deans' Perceptions of Research and Development Facilities Needs.* Within each institution selected for the telephone survey, research administrators were selected for interview. The science and engineering disciplines were each assigned to one-half of the sample. For each of the selected disciplines, deans were identified for interview, except in those cases where that discipline was not offered by the institution.

During the course of data collection, five of the institutions included in the mail survey and four of those included in the telephone survey were determined to be ineligible, due to the lack of dedicated research and development facilities in science and engineering at those institutions. This resulted in a sample of 165 institutions for the mail survey and 81 institutions, represented by 81 research administrators and 175 eligible deans speaking for 325 science and engineering programs, for the telephone survey.

The 165 institutions included 108 public and 57 private doctorate-granting universities. Forty-seven of the universities were among the top 50 nationally in 1984 research expenditures. Seventy-five of the universities had medical schools on their campuses. The institutions were geographically dispersed. About one-third of the universities (53) were located in the Northeast, about one-fourth each in the North Central (40) and West/Southwest (42) regions, and about one-fifth (30) in the South.

The Survey Instruments

The Mail Questionnaire

The National Science Foundation developed a questionnaire to collect information on research and development space, costs and age for universities as a whole, and limited information on facilities in nine science and engineering disciplines (see Appendix B). The final questionnaire consisted of four main items:

- Item 1 collected the total square footage devoted to research and development, based on the definitions in Office of Management and Budget circular A-21. For a discussion of this measure see Data Considerations, below.
- Item 2 collected information on the costs associated with major repairs, upgrading and renovation, and new construction of research facilities. Data were requested for work in progress (academic year 1985-85) and for construction planned in the next five years (academic years 1986-87 through 1990-91). For each type and period of construction, sources of funding were requested.
- Item 3 collected information on the proportion of facilities which were built or underwent their most recent significant renovation during selected time periods.
- Item 4 collected information on facilities in nine science and engineering disciplines, including the number of existing facilities, the age of the oldest and newest facility, and whether new space was under construction or planned.

Data Considerations

The data on research facilities provided by the institutions should be regarded as estimates. The following sections discuss the issues related to the data collected in the mail survey, and provide a context for interpreting the findings.

Space. As the measure of research and development space, the survey used the net assignable square feet associated with research and development as stated on OMB Circular A-21 (recoverable space). While this information was available from virtually all respondents, some institutions commented that recoverable space understated total research space.

A sample of respondents, stratified by amount of space reported, received followup calls about the ratio of recoverable to total research space on their campus. Thirty institutions were contacted, 3 in each space decile. Based on the sample responses, reported recoverable space represents 100 percent of total research space at about 50 percent of the universities.[9] Another 15 percent of the respondents said that recoverable space was at least 90 percent of total space. Only one institution said that recoverable space was less than 70 percent of the total space. Furthermore, there was no systematic difference in the ratio of recoverable to total space by space decile.

Costs. There were three basic problems encountered in collecting data on costs associated with building research and development space. The first of these is the disaggregation of data by cost category: major repairs, upgrading and renovation, and new construction. At some universities (about 10 percent), the respondents were unable to separate the costs associated with major repairs and upgrading/renovation. This is because both types of work are often done on the same building at the same time in the interest of efficiency. The same problem applies to some universities (7 percent) in separating the costs associated with upgrading/renovation and new construction. As a result, some of the data represent both repair and upgrading/renovation costs or both upgrading/renovation and new construction costs.

The second problem in collecting cost data is also related to disaggregation of information, in this case by purpose of the space being repaired, renovated, or constructed. While some projects are specifically related to building for a given use, others involve space that will be used for a variety of purposes. In such cases, the building costs directly related to research may be difficult to disaggregate. It seems reasonable to assume that, in some disciplines at least, the research space may represent a higher cost per square foot than, say, instructional space. This is particularly problematic for planned construction, where the portion of space to be used for each purpose in unknown, but is also occasionally a problem for construction in progress. The same problem is encountered when requesting the increased square footage resulting from construction associated with research. Some universities knew how much square footage would result from the construction, but did not know how much would be associated with research. Still others knew the gross square footage resulting from construction, but not net assignable square footage.

---

[9] A small number of these institutions reported total research space instead of recoverable space, indicating that they do not calculate the latter.

The third problem in collecting cost information is in requesting projections for planned construction. Some universities reported that, while they have plans for future building projects, the plans had not yet been approved. In this survey, data were included even if approval had not yet been obtained. Some institutions, while they can project building costs, cannot report the sources of their building funds; this information is sometimes not known until the funding for a given project is actually "packaged."

Facilities-Related Work. The number of institutions with facilities-related work in each of the six categories -- major repairs, upgrading and renovation, and new construction, both in progress and planned -- was derived by counting the non-zero responses to Item 2 (Table 4). Non-zero respondents that reported they could not disaggregate major repairs and upgrading were counted in both categories. Similarly, those that could not disaggregate renovations and new construction were counted in both categories. The total number of institutions with new construction, both in progress and planned, exceed the number of institutions adding space (Table 2) because some new construction is replacing existing space.

Age of facilities. The questionnaire asked institutions to report the age of their facilities since building or the most recent significant renovation. The amount of infomation on renovation contained in facilities inventories varied in this regard. Some inventories do not include renovations, and others include only additions to a building. As a result, these data represent the universities' best estimates of facility age.

In addition, post-survey followup calls to all survey respondents revealed that 85 percent of them reported on the age of buildings that house research space, despite the fact that the questionnaire defined "R&D facilities" in terms of research space. Nonetheless, the average age distribution of buildings was similar to the average age distribution of research space as reported by the remaining 15 percent of respondents (Table 5).

Table 4. Number of Institutions Reporting Facilities-Related Work

	Type of University						
	All	Top 50	Below Top 50	With Medical School	Without Medical School	Public	Private
Work in Progress							
Major Repairs	123	42	81	62	60	81	42
Upgrading and Renovation	127	36	91	67	60	81	46
New Construction	103	36	67	54	49	78	25
Planned Work							
Major Repairs	133	44	89	64	69	90	43
Upgrading and Renovation	139	40	98	68	71	96	43
New Construction	137	45	92	67	70	97	40

Table 5. Average Proportion of Academic Research Facilities Built or Renovated in Selected Time Periods, by How Item was Reported

Period	Buildings	Research Space
1980-86	18.3%	21.6%
1970-79	25.4%	20.1%
1960-69	29.1%	34.8%
1940-59	15.3%	14.4%
Before 1940	12.0%	9.1%
Number of Respondents	115	20

The Telephone Questionnaire

A brief telephone interview questionnaire was developed to solicit the opinions of the research administrators and deans about the institutions' research facilities needs and problems associated with addressing those needs. The items included:

- the sufficiency of the amount of research and development space;
- the most critical need in terms of research and development space;
- ways in which facilities needs affect the research program at the university;
- how additional unrestricted research funds would be used, were they to become available;
- areas in which support would be reduced if the university were to experience a reduction in research support;
- problems in addressing research facilities needs;
- general condition of research and development space;
- whether facilities needs are the most pressing problem facing research at the university in the next five years.

The Response Rates

The mail questionnaires were distributed in late March 1986. By the survey closing date of June 6, responses had been received from 137 of the eligible 165 institutions, an overall response rate of 83 percent (Table 6). More public (89 percent) than private (72 percent) institutions responded. The response rates were similar for top 50 research institutions and others (79 percent compared with 85 percent). Because the response rate among public institutions was substantially higher than among private institutions, the final adjustment of the data for nonresponse included separate weights for public and private institutions, based upon the response rate for each group.

The telephone survey began in mid-April 1986 with the collection of the deans' and research administrators' names from the HES survey coordinators on each campus. A total sample of 406 potential interviews resulted, including 81 research administrators and 175 deans representing 325 science and engineering programs. Data were collected during the period from April 28 through May 21, 1986. A total of 398 interviews were completed with 80 research administrators and 173 deans representing 318 programs, for a response rate of 98 percent overall, 99 percent for research administrators, and 98 percent among deans.

Table 6. Response Rates to the Mail Survey

Institution Type	Sample	Responses	Percent	Non-Responses
All	165	137	83.0	28
Public	108	96	88.9	12
Private	57	41	71.9	16
Top 50 R&D	47	38	80.8	9
Other	118	99	83.9	19

Table A-1. Costs to Complete* Facilities-Related Work in Progress, 1985-86.

	Type of University						
	All	Top 50	Below Top 50	With Medical School	Without Medical School	Public	Private
Major Repairs							
No. of Institutions	111	39	71	53	58	72	39
Costs	(in thousands)						
Total	$ 112,979	$ 63,800	$ 49,178	$ 48,879	$ 64,100	$ 65,274	$ 47,704
Average	$ 1,018	$ 1,617	$ 688	$ 919	$ 1,111	$ 907	$ 1,225
Upgrading and Renovation							
No. of Institutions	101	31	70	56	45	62	39
Costs	(in thousands)						
Total	$ 288,782	$160,282	$128,500	$215,813	$ 72,969	$185,194	$103,587
Average	$ 2,865	$ 5,253	$ 1,828	$ 3,854	$ 1,628	$ 2,993	$ 2,661
New Construction							
No. of Institutions	91	35	56	45	45	69	22
Cost	(in thousands)						
Total	$1,273,560	$705,225	$568,335	$726,622	$546,938	$953,767	$319,792
Average	$ 14,015	$ 20,296	$ 10,127	$16,004	$ 12,029	$ 13,898	$ 14,377

*In most cases, completion costs are expended in one year; however some construction projects extend beyond one year.

NOTE: Calculations of averages used unrounded data; calculations using rounded data may differ.

Table A-2. Costs to Complete Facilities-Related Planned Work in 1986-1991.

	Type of University						
	All	**Top 50**	**Below Top 50**	**With Medical School**	**Without Medical School**	**Public**	**Private**
Major Repairs							
No. of Institutions	113	41	72	48	66	74	39
Cost				(in thousands)			
Total	$ 615,663	$ 370,781	$ 244,882	$ 211,210	$ 404,453	$ 349,977	$ 265,685
Average	$ 5,440	$ 9,079	$ 3,385	$ 4,438	$ 6,167	$ 4,713	$ 6,825
Upgrading and Renovation							
No. of Institutions	102	34	68	47	55	69	33
Cost				(in thousands)			
Total	$1,141,217	$ 869,300	$ 271,918	$ 883,990	$ 257,267	$ 673,428	$ 467,789
Average	$ 11,189	$ 25,653	$ 3,993	$ 18,785	$ 4,683	$ 9,813	$ 14,020
New Construction							
No. of Institutions	124	45	79	57	68	87	38
Cost				(in thousands)			
Total	$4,030,817	$2,541,783	$1,489,034	$2,068,640	$1,962,176	$2,712,907	$1,317,910
Average	$ 32,464	$ 56,392	$ 18,827	$ 36,556	$ 29,038	$ 31,318	$ 35,110

NOTE: Calculations of averages used unrounded data; calculations using rounded data may differ.

Table A-3. Sources of Funding for Facilities-Related Work in Progress, 1985-86.

	Type of University						
	All	Top 50	Below Top 50	With Medical School	Without Medical School	Public	Private
Major Repairs	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Federal	9.0	11.3	6.0	5.7	11.5	0.9	19.9
State	50.2	38.5	65.1	56.9	45.0	73.3	18.8
Tax-exempt Bonds	9.5	8.6	10.8	4.4	13.5	5.6	14.8
Private Donation or Endowment	23.7	36.7	7.0	20.6	26.1	12.3	39.0
Other	7.6	4.9	11.1	12.4	3.9	7.9	7.4
Upgrading and Renovation	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Federal	8.2	10.7	5.2	9.4	4.7	2.2	19.0
State	29.6	30.1	29.0	22.8	49.9	43.2	5.3
Tax-exempt Bonds	30.9	27.8	34.7	37.4	11.5	31.9	29.1
Private Donation or Endowment	22.5	24.0	20.5	19.2	32.2	13.9	37.9
Other	8.8	7.4	10.6	11.2	1.7	8.8	8.7
New Construction	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Federal	9.5	9.4	9.7	13.2	4.5	0.8	35.4
State	40.2	47.7	31.0	40.9	39.2	53.0	2.5
Tax-exempt Bonds	29.5	21.5	39.4	23.8	37.3	35.0	13.4
Private Donation or Endowment	13.8	15.5	11.8	15.8	11.1	8.8	28.5
Other	7.0	5.9	8.1	6.2	7.9	2.4	20.2

Table A-4. Sources of Funding for Facilities-Related Planned Work, 1986-1991.

	Type of University						
	All	Top 50	Below Top 50	With Medical School	Without Medical School	Public	Private
Major Repairs	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Federal	5.6	9.2	0.3	4.8	9.1	0.5	10.7
State	37.6	22.7	60.0	30.9	42.0	74.8	0.8
Tax-exempt Bonds	17.1	19.8	13.0	25.9	11.2	1.1	32.9
Private Donation or Endowment	29.5	43.5	9.9	20.9	35.3	15.7	43.2
Other	10.2	4.8	16.9	21.9	2.4	7.9	12.5
Upgrading and Renovation	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Federal	8.3	8.2	8.5	10.1	2.0	0.7	19.2
State	49.6	51.9	42.1	49.2	50.9	70.4	19.6
Tax-exempt Bonds	11.4	8.8	19.7	10.6	14.0	14.8	6.5
Private Donation or Endowment	25.9	26.9	25.6	23.9	32.7	7.7	52.2
Other	4.9	5.2	4.1	6.2	0.4	6.5	2.6
New Construction	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Federal	5.7	2.3	11.7	5.4	6.0	3.7	9.6
State	43.7	41.3	47.9	45.4	41.8	61.4	8.9
Tax-exempt Bonds	25.4	29.3	18.4	20.4	30.9	22.1	31.7
Private Donation or Endowment	24.9	26.6	21.9	28.0	21.4	12.7	48.9
Other	0.3	0.5	0.1	0.8	0.0	0.1	0.8

Table A-5. Average Proportion of Academic Research Facilities Built or Renovated in Selected Time Periods.

	Type of University						
	All	Top 50	Below Top 50	With Medical School	Without Medical School	Public	Private
1980 - 1986	18.1%	14.7%	19.4%	15.9%	20.0%	15.1%	24.0%
1970 - 1979	25.1	20.3	26.9	27.0	23.5	27.3	20.7
1960 - 1969	30.3	28.7	30.9	28.4	32.0	31.1	28.8
1940 - 1950	14.8	20.5	12.6	16.0	13.8	16.1	12.2
Before 1940	11.7	15.7	10.1	12.8	10.7	10.3	14.4
No. of Cases	156	44	112	71	85	104	53

Table A-6. Academic Officials' Opinions Regarding Condition of Campus Research Facilities, 1986.

	Condition of Research Facilities					
	No. of Interviews	**Excellent**	**Good**	**Fair**	**Poor**	**Don't* Know**
Research Administrators	80	4%	44%	45%	4%	4%
Deans						
Engineering	29	7	34	48	10	0
Physical Sciences	39	0	31	51	10	8
Life Sciences	39	8	38	41	10	3
Environmental Sciences	33	3	21	52	21	3
Medical Sciences	25	8	48	28	8	8
Computer Sciences	37	14	32	41	14	0
Mathematical Sciences	39	0	38	44	10	8
Psychology	38	3	37	26	24	11
Social Sciences	39	5	33	44	15	3

* Some deans were unable to select one response due, primarily to variation in the condition of facilities in the discipline.

Table A-7. Academic Officials' Assessments of Sufficiency of the Amount of Research Space

	Amount of Research Space			
	No. of Interviews	More Than Needed	About Right	Less Than Needed
Research Administrators	80	0%	5%	95%
Deans				
Engineering	29	0	7	93
Physical Sciences	39	0	21	79
Life Sciences	39	0	18	82
Environmental Sciences	33	0	27	73
Medical Sciences	25	0	28	72
Computer Sciences	37	3	11	86
Mathematical Sciences	39	3	33	64
Psychology	38	3	16	82
Social Sciences	39	0	8	92

Table A-8. Academic Officials' Identification of Most Critical Need In Terms of Research Space.

	Most Critical Need					
	No. Of Interviews	Additional Space	Upgrading Existing Space	Repair or Replace Existing Space	Other	Don't* Know
Research Administrators	80	75%	16%	6%	1%	1%
Deans						
Engineering	29	66	17	10	3	3
Physical Sciences	39	62	21	10	3	5
Life Sciences	39	67	28	3	3	0
Environmental Sciences	33	67	21	9	3	0
Medical Sciences	25	80	8	8	4	0
Computer Sciences	37	70	19	8	3	0
Mathematical Sciences	39	51	28	10	10	0
Psychology	38	50	32	11	5	3
Social Sciences	39	67	28	5	0	0

* Some respondents were unable to select the most critical need.

Table A-9. Academic Officials' Assessment of Major Problem Facing Research in Next Five Years

	Major Problem			
	No. of Interviews	Facilities	Personnel	Other
Research Administrators	80	36%	28%	36%
Deans				
Engineering	29	38	34	28
Physical Sciences	39	59	18	23
Life Sciences	39	33	31	36
Environmental Sciences	32	47	31	22
Medical Sciences	25	36	32	32
Computer Sciences	37	35	59	6
Mathematical Sciences	39	26	54	20
Psychology	38	29	42	29
Social Sciences	39	23	44	33

Table A-10. Academic Officials' Identification of Funding Priority

	Proportion of Academic Officials Reporting						
	No. of Interviews	Additional Funds Would Be Used First For			Reduced funds Would Be Withdrawn First From		
		Facilities	Equipment	Personnel	Facilities	Equipment	Personnel
Research Administrators	80	56%	26%	16%	64%	12%	21%
Deans							
Engineering	29	45	24	24	41	28	21
Physical Sciences	39	46	33	15	59	8	28
Life Sciences	39	49	21	23	74	8	10
Environmental Sciences	33	45	30	15	64	21	15
Medical Sciences	25	44	16	40	68	4	24
Computer Sciences	37	38	19	41	51	19	27
Mathematical Sciences	39	18	13	69	49	31	18
Psychology	38	45	21	32	61	18	21
Social Sciences	39	38	23	38	59	22	13

Table A-11. Proportion of Academic Officials Citing Effects of Facilities Needs on Research Programs.[1]

	No. of Interviews	Limits Number of Projects	Limits Type of Projects	Diverts Funds	Other	Personnel[2]
Research Administrators	80	89%	92%	81%	60%	31%
Deans						
Engineering	29	83	90	83	69	28
Physical Sciences	39	85	85	54	59	38
Life Sciences	39	87	85	85	59	20
Environmental Sciences	33	79	79	36	24	6
Medical Sciences	25	80	92	80	64	24
Computer Sciences	37	73	81	62	43	24
Mathematical Sciences	39	56	44	23	31	13
Psychology	38	89	76	76	66	26
Social Sciences	39	79	72	46	44	23

[1] Respondents answered "yes" to all statements that applied. Therefore, percentages do not sum to 100 percent.

[2] Research Administrators and Deans were not explicitly asked whether their facilities needs affect their ability to recruit and retain faculty, research personnel, and graduate students. However, a substantial number of respondents volunteered this response.

Table A-12. Proportion of Academic Officials Citing Problems in Addressing Facilities Needs.*

	Problems in Addressing Facilities Needs					
	No. of Interviews	Inability To Obtain Loans	Restrictions on Use of Grants	Legal Restrictions	Lack of Campus Space	Pressure to Develop Teaching Rather Than Research
Research Administrators	80	14%	48%	33%	38%	35%
Deans						
Engineering	29	21	41	14	52	17
Physical Sciences	39	8	26	18	41	21
Life Sciences	39	10	26	28	54	28
Environmental Sciences	33	0	22	21	33	24
Medical Sciences	25	4	28	16	44	20
Computer Sciences	37	8	32	22	43	38
Mathematical Sciences	39	8	21	3	36	28
Psychology	38	5	39	37	47	13
Social Sciences	39	10	33	13	59	31

---

*Respondents answered "yes" to all statements that applied. Therefore, percentages do not sum to 100 percent.

Table A-13. Research Administrators' Opinions Regarding Condition of Campus Research Facilities, 1986.

Type of University	No. of Interviews	Condition of Research Facilities				
		Excellent	Good	Fair	Poor	Don't* Know
All	80	4%	44%	45%	4%	4%
Top 50	24	8	46	38	4	4
Below Top 50	56	2	43	48	4	4
With Medical School	41	5	41	46	2	5
Without Medical School	39	3	46	44	5	3
Public	54	2	41	52	4	2
Private	26	8	50	31	4	8

* Some research administrators were unable to select one response due, primarily to variation in the condition of facilities in the discipline.

Table A-14. Research Administrators' Assessment of Sufficiency of the Amount of Research Space

		Amount of Research Space		
	No. of Interviews	More Than Needed	About Right	Less Than Needed
All	80	0%	5%	95%
Top 50	24	0	8	92
Below Top 50	56	0	4	96
With Medical School	41	0	5	95
Without Medical School	39	0	5	95
Public	54	0	6	94
Private	26	0	4	96

Table A-15. Research Administrators' Identification of Most Critical Need In Terms of Research Space.

		Most Critical Need				
	No. of Interviews	Additional Space	Upgrading Existing Space	Repair or Replace Existing Space	Other	Don't* Know
All	80	75%	16%	6%	1%	1%
Top 50	24	63	21	13	0	4
Below Top 50	56	80	14	4	2	0
With Medical School	41	80	17	0	2	0
Without Medical School	39	69	15	13	0	3
Public	54	74	13	9	2	2
Private	26	77	23	0	0	0

* Some respondents were unable to select the most critical need.

Table A-16. Research Administrators' Identification of Funding Priority

		Proportion of Academic Officials Reporting					
Type of University	No. of Interviews	Additional Funds Would Be Used First For			Reduced Funds Would Be Withdrawn First From		
		Facilities	Equipment	Personnel	Facilities	Equipment	Personnel
All	80	56%	26%	16%	64%	13%	21%
Top 50	24	63	29	8	67	8	17
Below Top 50	56	54	25	20	63	14	23
With Medical School	41	51	29	17	63	12	24
Without Medical School	39	62	23	15	64	13	18
Public	54	54	26	19	61	15	22
Private	26	62	27	12	69	8	19

Table A-17. Proportion of Research Administrators Citing Effects of Facilities Needs on Research Programs.*

Type of University	No. of Interviews	Limits Number of Projects	Limits Type of Projects	Diverts Funds
All	80	89%	92%	81%
Top 50	24	88	88	75
Below Top 50	56	89	95	84
With Medical School	41	90	93	83
Without Medical School	39	87	92	79
Public	54	93	94	78
Private	26	81	88	88

---

*Respondents answered "yes" to all statements that applied. Therefore, percentages do not sum to 100 percent.

Table A-18. Proportion of Research Administrators Citing Problems in Addressing Facilities Needs.*

		Problems in Addressing Facilities Needs				
Type of University	No. of Interviews	Inability To Obtain Loans	Restrictions on Use of Grants	Legal Restrictions	Lack of Campus Space	Pressure to Develop Teaching Rather Than Research
All	80	14%	48%	33%	38%	35%
Top 50	24	17	58	38	29	25
Below Top 50	56	13	43	30	41	39
With Medical School	41	12	46	32	41	37
Without Medical School	39	15	49	33	33	33
Public	54	9	33	33	31	33
Private	26	23	77	31	50	38

---

*Respondents answered "yes" to all statements that applied. Therefore, percentages do not sum to 100 percent.

Table A-19. Oldest and Newest Facilities: Date of Construction, or Most Recent Renovation*

	No. of Programs	Oldest		Newest	
		Median	Range	Median	Range
Engineering	130	1941	1874-1986	1980	1941-1986
Physical Sciences	156	1953	1895-1986	1974	1930-1986
Environmental Sciences	130	1946	1855-1986	1974	1855-1986
Mathematical Sciences	141	1966	1859-1982	1968	1885-1986
Computer Sciences	140	1966	1861-1986	1972	1902-1986
Life Sciences	156	1948	1844-1986	1980	1861-1986
Medical Sciences	111	1957	1878-1983	1979	1920-1986
Psychology	148	1958	1873-1986	1969	1894-1986
Social Sciences	147	1940	1851-1984	1972	1908-1986

*Most institutions were unable to identify the date of facilities renovations, so they responded based on construction dates.

APPENDIX B

Survey Questionnaires

NATIONAL SCIENCE FOUNDATION
WASHINGTON, D.C. 20550

March 20, 1986

Dear Colleague:

I am writing on behalf of the National Science Foundation to request your assistance in a matter of some urgency. Acting out of the concern expressed by the academic community, Congress has instructed the Foundation to collect information on the status and condition of academic research and development facilities and submit a report to Congress by September 1, 1986.

The enclosed questionnaire is designed to provide the information needed to respond to the Congressional mandate. The survey is being conducted through the Higher Education Surveys (HES) project by Westat, Inc., under contract to the Foundation. We are asking 170 doctorate-granting institutions to participate in the survey.

Your assistance in completing this survey is vital to achieving an accurate representation of academic R&D facilities. Please complete and return the questionnaire to the HES panel representative at your institution.

Thank you for your assistance.

Sincerely,

William L. Stewart
Director, Division of
Science Resource Studies

OMB# 3145-0009
Exp. 3/31/87

HIGHER EDUCATION SURVEY OF ACADEMIC SCIENCE AND ENGINEERING R&D FACILITIES

DIRECTIONS AND DEFINITIONS:

Research and Development (R&D) Facilities: All research and development operations space, controlled environment space (such as clean or white rooms), technical support space (such as carpenter and machine shops), and research animal laboratories (including space for animal production colonies, holding rooms, isolation and germ-free rooms).

Be sure to report all your R&D facilities including branches, museums, field laboratories, rented space, etc. Do not include campus-wide facilities (e.g., central libraries and computers) or instrumentation. Do not include facilities not administered by the university even if they are used by faculty (e.g., independent research institutes).

Costs: Report the total cost of building directly related to R&D facilities. For multi-use facilities, report a portion of the cost proportional to the amount of R&D space in the building (e.g., if 20% of a building's space is assigned to R&D, report 20% of the cost of a new roof for the building).

Sources of Funds: Report the proportion of building funds obtained from the sources listed. In reporting state funds, do not include state funds (if any) which are part of the university's normal operating budget.

Disciplines: The following fields are illustrative of science and engineering disciplines, for your use in answering question 4. Include all fields within these discipline areas at your institution, even if not listed as an example here. Use your best judgement in reporting fields that cross over discipline categories used in this survey.

Engineering: Aeronautical and astronautical, chemical and petroleum, civil and environmental, electrical and electronic, mechanical, industrial and management, marine and ocean, agricultural, mining, metallurgical and materials, nuclear, and other engineering programs.

Physical Sciences: Astronomy and astrophysics, chemistry (excluding biochemistry), physics, and other disciplinary and multidisciplinary programs within the physical sciences.

Life Sciences: Agricultural sciences, agronomy, conservation, and wildlife, biological sciences, bioengineering, anatomy, biochemistry, biophysics, biotechnology, ecology, plant science, botany, zoology, pathology, microbiology, pharmacology, veterinary biology and other multidisciplinary programs within the life sciences.

Environmental Sciences: Atmospheric and earth sciences, aeronomy, meteorology, geology, geochemistry, geophysics, paleontology, seismology, oceanography, and other disciplinary and multidisciplinary programs within the environmental sciences.

Medical Sciences: Anesthesiology, cardiology, endocrinology, gastroenterology, hematology, neurology, obstetrics, ophthalmology, psychiatry, radiology, surgery, dentistry, pharmacy, and preventive and veterinary medicine.

Computer Sciences: Design, development, and application of computer capabilities for data storage and manipulation, information science.

Mathematical Sciences: Algebra, analysis, applied mathematics, foundations and logic, numerical analysis, statistics, topology.

Psychology: Animal behavior, clinical, educational, experimental, human development and personality, social.

Social Sciences: Economics, political science, sociology, anthropology, socio-economic geography.

SUMMARY OF UNIVERSITY R&D FACILITIES

---

1. SPACE: Give your best estimate of the net assignable square feet devoted to R&D, using indirect costs as the basis of your estimate (i.e., costs calculated for OMB Circular A-21). Include both space that is dedicated to R&D and space that is shared between R&D and instruction. Exclude research space that is used for instruction only. ______________sq.ft.

2. COSTS: Indicate the estimated completion costs (capitalized and others) in current dollars of each type of major R&D construction project currently in progress or planned within the next five years (i.e., included in a five-year plan). Also, indicate the percentage financed by each of the sources listed.

	Work in Progress (AY 1985-86)*	Planned Construction (AY 1986-87 to 1990-91)*
MAJOR REPAIRS. Costs associated with repairing deteriorated conditions, such as a new roof.	$__________	$__________
Percent Federally funded	__________%	__________%
Percent funded through State budget	__________%	__________%
Percent funded through tax exempt bonds issued by the institution	__________%	__________%
Percent funded through private donation/endowment	__________%	__________%
UPGRADING AND RENOVATION. Costs associated with enhancing the R&D capability of a facility, complying with government regulations, or gutting and rebuilding an existing facility.	$__________	$__________
Percent Federally funded	__________%	__________%
Percent funded through State budget	__________%	__________%
Percent funded through tax exempt bonds issued by the institution	__________%	__________%
Percent funded through private donation/endowment	__________%	__________%

NOTE: If you are unable to provide separate cost figures for major repairs and upgrading/renovation, check here ___ and enter total figures under major repairs.

NEW CONSTRUCTION. Costs associated with building a new facility or adding on to an existing one.	$__________	$__________
Percent Federally funded	__________%	__________%
Percent funded through State budget	__________%	__________%
Percent funded through tax exempt bonds issued by the institution	__________%	__________%
Percent funded through private donation/endowment	__________%	__________%
Net change in square feet (show + or -)	_______sq. ft.	_______sq. ft.

NOTE: If you are unable to separate renovation and new construction costs associated with the same building project, check here ____ and include total figures under new construction.

*AY: Academic Year

3. AGE. Please indicate the percentage of your R&D facilities which were built or underwent a significant renovation (whichever is more recent) in the following periods (e.g., a facility built in 1940 and completely renovated in 1984 would be included in category a.) (PERCENTS SHOULD SUM TO 100.)

a. 1980 through 1986	________%
b. 1970 through 1979	________%
c. 1960 through 1969	________%
d. 1940 through 1959	________%
e. Before 1940	________%
TOTAL	100 %

4. DISCIPLINES. Please indicate the number of existing R&D facilities for the following disciplines (or NA for not applicable) in Column A. A given building may be reported for more than one discipline if it houses facilities for each. Therefore, the sum of Column A may exceed the number of buildings on your campus with R&D facilities.

For each applicable field, enter the age (since construction or most recent renovation) for the oldest and newest facility in each discipline. In the last Column (D), check those disciplines for which new facilities are currently (AY 1985-86) under construction or planned (AY 1986-87 to AY 1990-91).

A. Number of Existing Facilities		B. Age of Oldest Facility	C. Age of Newest Facility	D. New Space Under Construction or Planned
___	Engineering	______yrs.	______yrs.	________
___	Physical Sciences	______yrs.	______yrs.	________
___	Life Sciences	______yrs.	______yrs.	________
___	Environmental Sciences	______yrs.	______yrs.	________
___	Medical (Health) Sciences	______yrs.	______yrs.	________
___	Computer Sciences	______yrs.	______yrs.	________
___	Psychology	______yrs.	______yrs.	________
___	Mathematical Sciences	______yrs.	______yrs.	________
___	Social Sciences	______yrs.	______yrs.	________

Is there a medical school on your campus? __Yes __No

Person Completing Form: ____________________ Phone: ____________________

Title/Department: ____

QUESTIONS:

Call Mary Collins or Laurie Lewis at Westat's toll free number, (800)638-8985

OMB# 3145-0009
Exp. 3/31/87

HIGHER EDUCATION SURVEYS
SURVEY #2: DEAN'S PERCEPTIONS OF R&D FACILITIES NEEDS

Hello, my name is ______________. I am calling in regard to the Higher Education Surveys. (COORDINATOR), who is our survey coordinator at (INSTITUTION), may have told you that we would be calling.

We are currently conducting a survey on academic research and development facilities, sponsored by the National Science Foundation. Your participation in this survey is voluntary. Results from this survey will form the basis for a Foundation report to Congress in September. The data reported will not identify individuals or institutions.

We are asking the Deans responsible for selected science and engineering programs to share their perceptions of facilities needs. By "facilities," we mean all research and development operations space, controlled environment space, technical support space, and research animal laboratories. This includes branches, museums, field laboratories and rented space, however, it does not include campus-wide facilities or instrumentation costing under one million dollars.

This interview is designed to solicit opinions, judgments and impressions, not "hard" institutional data.

I understand from (COORDINATOR) that you are the (Dean/ALTERNATE TITLE) of (DISCIPLINE/S). Is that correct?

CORRECT FORM AS NECESSARY. IF R IS NOT RESPONSIBLE FOR ONE OR MORE OF THE DISCIPLINES LISTED, ASK FOR THE RESPONSIBLE PERSON'S NAME AND TELEPHONE NUMBER. END INTERVIEW IF RESPONDENT IS NOT RESPONSIBLE FOR AT LEAST ONE OF THE DISCIPLINES LISTED.

I would like to ask you a few questions about research facilities in (DISCIPLINE/these disciplines). [Let's start with (FIRST DISCIPLINE).]

ADMINISTER THE QUESTIONNAIRE FOR EACH DISCIPLINE INDICATED.

DISCIPLINE: ____________________

1. I'd like to ask you first about the amount of R&D space in (DISCIPLINE) at your university. Would you say that you have more space than you need, about the right amount of space, or less R&D space than you need in (DISCIPLINE)? (CIRCLE ONLY ONE RESPONSE)

MORE SPACE THAN NEEDED.............1

ABOUT THE RIGHT AMOUNT OF SPACE....2

LESS SPACE THAN NEEDED.............3

2. Which of the following would you say is your university's most critical need in terms of R&D space for (DISCIPLINE)? (CIRCLE ONE RESPONSE)

Additional space.............1 (Q3)

Upgrading of existing space..2 (Q3)

Repair or replacement of
deteriorated space...........3 (Q3)

Or something else............4 (Q2a)

2a. What is that? (RECORD COMMENTS VERBATIM BELOW)

____

____

____

____

3. Are there any specific program areas in (DISCIPLINE) that have significant facilities needs? (RECORD COMMENTS VERBATIM BELOW)

____

____

____

4. Do your needs related to facilities have any of the following effects? (CIRCLE YES OR NO FOR EACH)

Limit the number of projects
that can be done.................. Y N

Limit the types of projects
that can be done.................. Y N

Divert funds from other uses
to repair, maintain, or construct
facilities........................ Y N

4a. Are there other ways that facilities needs have affected the research program in (DISCIPLINE) at your university?

YES.........................1 (Q4b)

NO..........................2 (Q5)

4b. What are they? (RECORD COMMENTS VERBATIM BELOW)

5. Suppose additional, unrestricted (DISCIPLINE) research funds were available. Assuming the amount were enough to support any of these areas, would you be more likely to use these funds primarily to support personnel, to purchase equipment, to improve or expand facilities, or for some other purpose? (CIRCLE ONE)

PERSONNEL...................1 (Q5a)

EQUIPMENT...................2 (Q6)

IMPROVE/EXPAND FACILITIES....3 (Q6)

OTHER 4 (Q5b)

5a. What type of personnel: faculty, graduate students, postdoctorates, nonfaculty researchers, or other staff? (CIRCLE ALL THAT APPLY)

FACULTY..............................1
GRADUATE STUDENTS.................2
POSTDOCTORATES....................3
NON-FACULTY RESEARCHERS...........4
OTHERS.............................5

(Q6)

5b. What other purpose? (RECORD COMMENTS VERBATIM BELOW)

____

____

____

6. If your university were to experience a reduction in (DISCIPLINE) research support, in what order would you reduce support for the following? (RANK CATEGORIES)

	RANK
Personnel	____
Equipment purchases.........	____
Facilities improvement or expansion...................	____
(OTHER RESPONSE TO 5b)......	____

6a. For what type of personnel would you reduce support: faculty, graduate students, postdoctorates, nonfaculty researchers, or other staff? (CIRCLE ALL THAT APPLY)

FACULTY...........................1

GRADUATE STUDENTS.................2

POSTDOCTORATES....................3

NON-FACULTY RESEARCHERS...........4

OTHERS............................5

7. Which of the following areas present problems for your institution in addressing its (DISCIPLINE) facilities needs? (READ ALL RESPONSES; CIRCLE YES OR NO FOR EACH)

Inability to obtain loans...	Y	N
Restrictions on use of endowments or grants........	Y	N
Legal restrictions such as government regulations or community zoning laws.......	Y	N
Lack of campus space for additional facilities.......	Y	N
Pressure to develop teaching rather than research capability..................	Y	N

7a. Any others? (What would that be?) (RECORD COMMENTS VERBATIM BELOW)

____

____

____

(IF MORE THAN ONE YES RESPONSE TO 7 AND 7a, CONTINUE. OTHERWISE GO TO 9)

8. Which of the problem areas we just talked about do you consider the major problem in addressing (DISCIPLINE) facilities needs? (CIRCLE ONE RESPONSE; READ CATEGORIES IF NECESSARY)

INABILITY TO OBTAIN LOANS....1

RESTRICTIONS ON USE OF
ENDOWMENTS OR GRANTS.........2

LEGAL RESTRICTIONS SUCH AS
GOVERNMENT REGULATIONS OR
COMMUNITY ZONING LAWS........3

LACK OF CAMPUS SPACE FOR
ADDITIONAL FACILITIES. 4

PRESSURE TO DEVELOP TEACHING
RATHER THAN RESEARCH
CAPABILITY...................5

(OTHER RESPONSE TO 7a).......6

9. Now I would like to ask about the condition of your R&D space. Would you say that, on the whole, the condition of (DISCIPLINE) space is excellent, good, fair or poor? (CIRCLE ONLY ONE RESPONSE)

EXCELLENT....................1

GOOD.........................2

FAIR.........................3

POOR.........................4

10. Do you consider facilities, that is "bricks and mortar," the most pressing problem facing (DISCIPLINE) research at your university during the next five years?

YES.......................1 (Q11)

NO........................2 (Q10a)

10a. What do you consider the major problem facing (DISCIPLINE) research on your campus during the next five years? (RECORD COMMENTS VERBATIM BELOW)

11. Are there any other issues, that we have not talked about, which you feel are important to the assessment of (DISCIPLINE) R&D facilities on your campus? (RECORD COMMENTS VERBATIM BELOW)

ADMINISTER QUESTIONNAIRE FOR OTHER DISCIPLINES, IF INDICATED: Now I would like to talk with you about (NEXT DISCIPLINE).

Thank you for assistance in this research.